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ELECTRICAL WORLD

MAY 31, 1930
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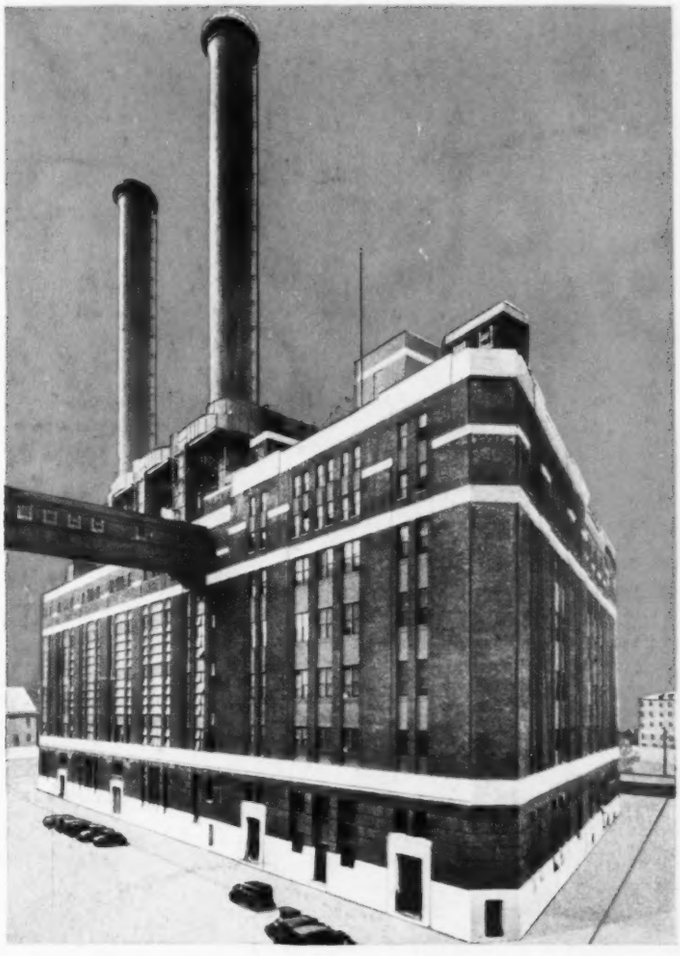

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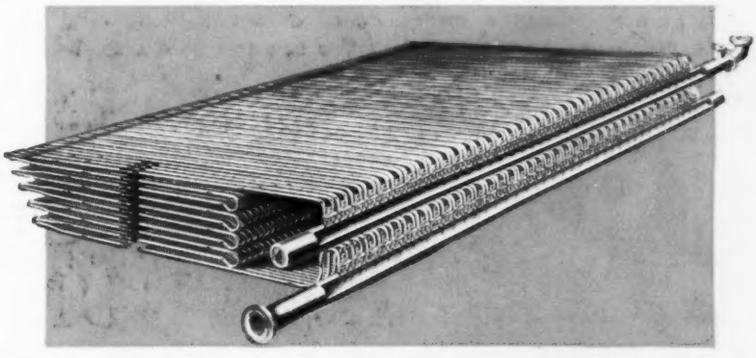

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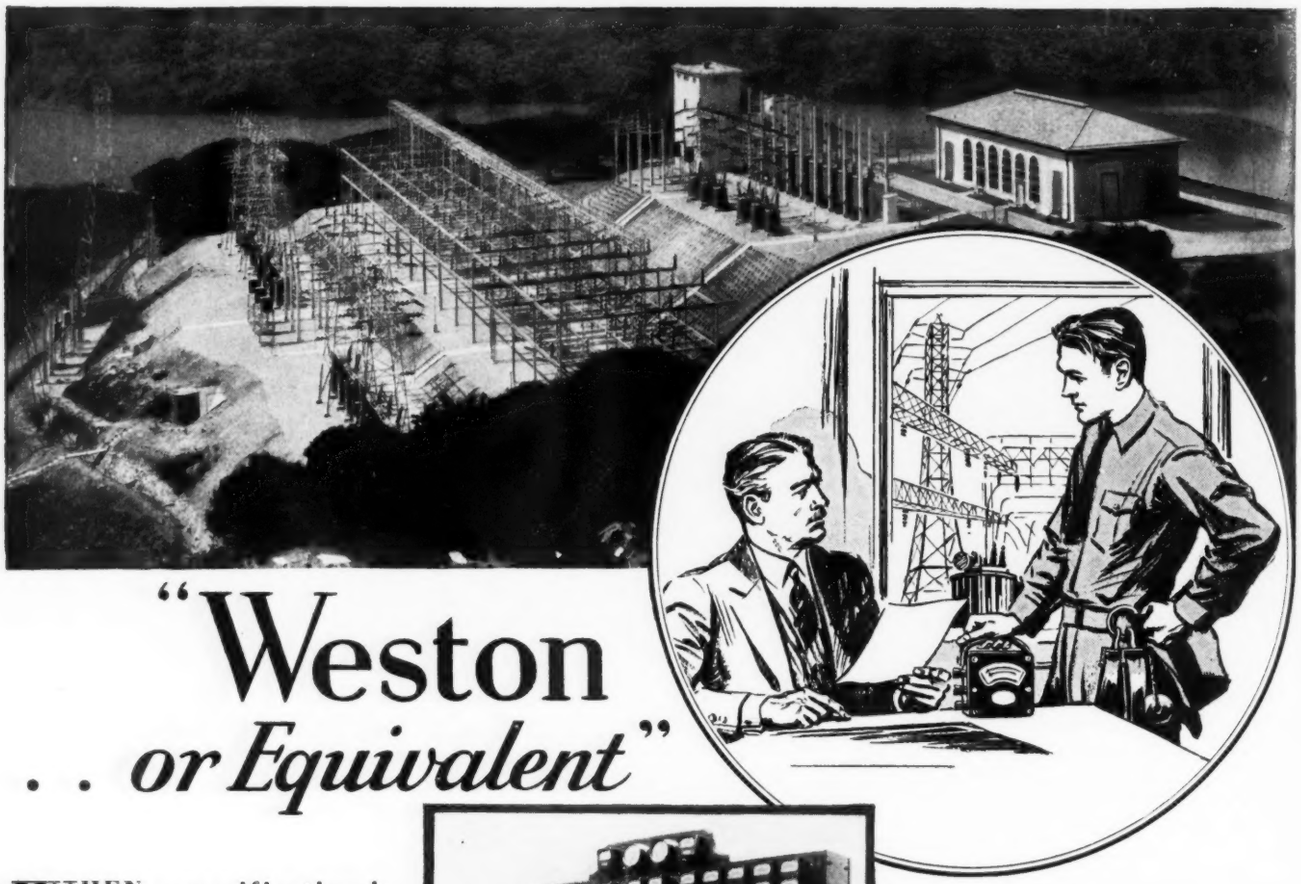
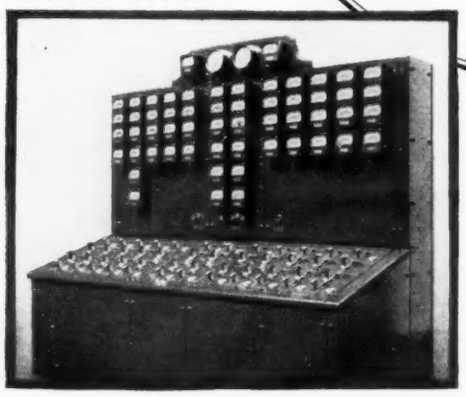


"Weston . . . *or Equivalent*"



WHEN a specification is drawn embodying these words, it is done with a commendable desire on the part of Purchasing Departments to procure competition and other sources of supply. What the buyer also hopes for is equivalence in all but price.

But stripped of hope or desire such specifications set up a standard—Weston, because of the intrinsic merits known the world over to be built into a Weston product. Since a "Weston" is thus acknowledged to be a satisfactory product, it is obvious that the buyer has a reasonable doubt about other instruments and is therefore interested in determining what the alleged "equivalent" must do to qualify.

Must it be equivalent in the sense of conforming to some initial tests of relatively broad scope? Or must it give satisfactory assurance of dependable performance when subjected to the use for which it may be acquired?

The "equivalent" will generally be slightly lower in cost at the time of purchase, but this advantage rapidly disappears when cost is properly determined on the basis of service rendered.

Most public utility engineers know that a specification drawn to read, "Weston or equivalent" is unwittingly fallacious since experience has taught them that there is no instrument equivalent to a "Weston" in design, workmanship and continuous performance. Nor does any instrument actually cost as little to procure and use.

For example, in selecting Weston Rectangulars for power plant and substation switchboards, they know that they can remove the price tags at the time of purchase—that there will be neither deterioration in service nor erratic behavior to cause further levy. They know that the testing reports from their men are final with all "Westons"—switchboard or portable—and that no other instruments give an equivalent feeling of confidence.

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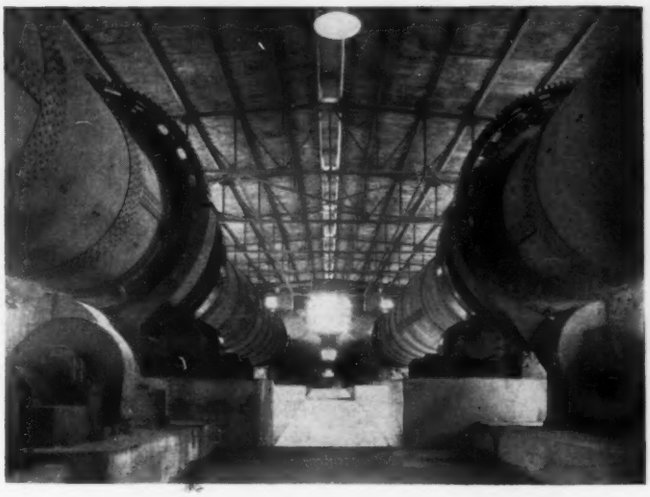

MAY 31, 1930

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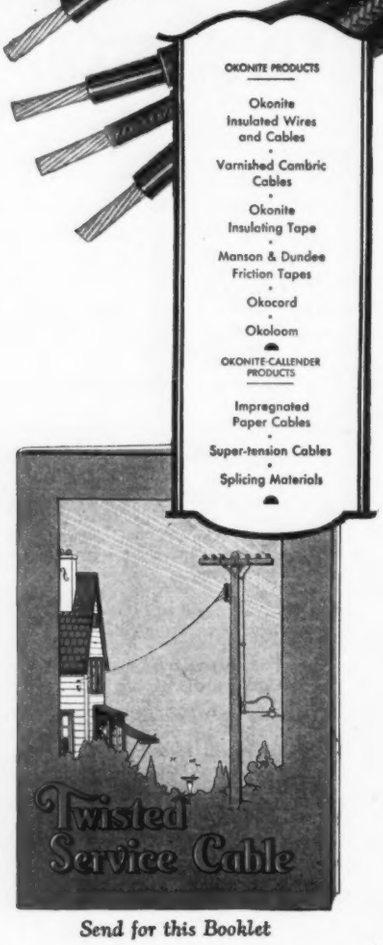

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ELECTRICAL WORLD

for the Week Ending

May 31, 1930

New York systems plan closer ties

Electrochemists meet in St. Louis

North American hearings postponed

Utility hysteria hits Canadian House

—UNIFICATION of industry groups planned in California. Organization, not yet named, will work for the good of all electrical interests.

—NORTH AMERICAN Company hearings postponed indefinitely. Not enough time to assimilate the evidence, is the reason given. July 1 is the end of the Trade Commission season anyway and lengthy matters must wait until fall.

—ELECTRIC ways are good, electrochemists hear; but don't expect the impossible and keep the economics of the case in mind, is warning of several speakers at convention.

—INDIANA interests reach for a shining sword to protect the people against proposed kilowatt-hour tax. General Assembly contemplates impost of one-half cent per kilowatt-hour.

—EARNINGS of electric light and power companies continue to exceed last year's, though by a slim margin. Compared with April, 1928, they are up 12 per cent.

—CANADIAN House of Commons now involved in anti-power company hysteria. High crimes and treasons glibly intimated in matters which Minister of Public Works promptly passes to provincial authorities.

—WINDOWLESS plants, using full artificial illumination, urged by consulting engineer as cheaper than present ones and conducive to better working conditions. What will the machine age detractors have to say now?

—REGULATORY and valuation problems are the present sources of discord, M. S. Sloan tells N.E.L.A., conceding that there are some wrongs and quite a few rights involved.

NEWS OF THE WEEK

New York State Unification Plan Nears Working Basis

FLOYD L. CARLISLE, chairman of the board Niagara Hudson Power Corporation, was elected to the directorate of the New York Edison Company on Tuesday of this week. This is the first official relationship to be established between the large up-state interests and the New York City companies. It precedes the consummation of electrical interconnection between the two power systems and brings nearer the delivery of hydro-electric power from up state as anticipated in previous statements by President M. S. Sloan of the metropolitan companies.

Ultimate unification of the properties through minority ownership of sufficient stock blocks by the United Corporation is foreseen in financial and utility circles. This, in turn, is viewed as but a preliminary to a great Eastern combination for the Atlantic seaboard. Election of Mr. Carlisle as a trustee of the Consolidated Gas Company is seen as a probable step. The New York Edison and its affiliated electric companies are controlled by Consolidated Gas Company of New York.

132-kv. interconnection well under way for power supply

The importance of the election of Mr. Carlisle to the New York Edison board was emphasized by the dedication on Wednesday of the new 30,000-hp. hydro-electric plant at Conklingville. This plant will be one of the "feeders" of power to the new transmission lines which will interconnect New York State and the upper Hudson Valley.

The transmission lines will be of 132,000-volt capacity over a greater part of the distance and of 110,000-volt capacity the rest of the way, between the power line network north of Albany and the transmission system of the metropolitan electric companies. The lines will parallel the Hudson River.

They will be built and operated by the individual companies involved, Niagara Hudson Power, Central Hudson Gas & Electric and the metropolitan electric companies.

It is primarily on account of the operating relationship to be established between the metropolitan and up-state power systems that Mr. Carlisle has been invited to sit on the New York Edison board, it is said, but financial observers see in his choice the promise of a more definite and permanent alignment between the two companies in the form of a merger.

▼

Electric Heat Chosen for Utility Offices

THE new three-story building of the Seaboard Public Service Company and the Virginia Public Service Company at Alexandria, Va., features an automatic electric heating system.

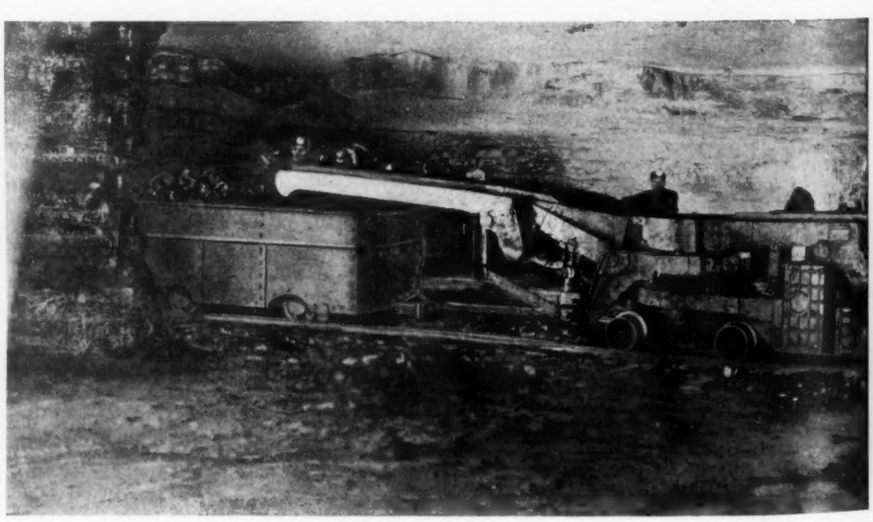
Heat is supplied to the rooms of the building through units, set in the walls of each room. These are controlled by thermostats, assuring a uniform temperature at all times. The thermostats permit a control range of from 60 to 80 deg. F.

Automatic switches also control the heat by floors, so that employees wishing to work when the building is ordinarly closed, may turn on the heat on the floor where they are working.

Warming of the auditorium is controlled by automatic devices which can be regulated in proportion to the number of persons in the hall.

Energy for the system enters the basement from a 2,300-volt distribution line, and is carried to a trans-

ELECTRICAL DINOSAUR IS



This huge machine, 57 ft. long and weighing 60,000 lb., resembles nothing quite so much as some prehistoric monster. The gatherer, operating on a swivel, picks up coal at the working face in the mine within a large radius, and delivers it to mine cars. A five-ton car can be loaded in 30 seconds. It is also able to exert a 60-ton force to dislodge coal not "shot down." It is all-electric and only two men are required to operate it. Installation is in the Woldwood mine of the Butler Consolidated Coal Company near Pittsburgh

former bank, where it is stepped down to 230 volts, on which the system is operated. It is expected by officials of the company that the practical example of electric space heating afforded by this building will play an important part in popularizing electric heating in Alexandria.

▼

Prove Process Values, Electrochemists Told

"THE progress of electrolytic methods in metallurgy is highly promising," T. H. Donahue, International Lead Refining Company, told the delegates to the 57th general meeting of the American Electrochemical Society in St. Louis this week. "Important increases in tonnage are recorded, new plant construction is under way and the methods are being applied to other metals. Electrolytically refined metals have marked advantages for many uses.

"Despite all this," Mr. Donahue continued, "it is well not to be overly optimistic, for metallurgy is a highly competitive field and the mortality among new processes is high. The tendency toward purer metals is not to be denied, but it is also well to recognize that no permanent premium can be expected for more than a limited amount of each and that success depends on being able to produce them more cheaply electrically than by other processes."

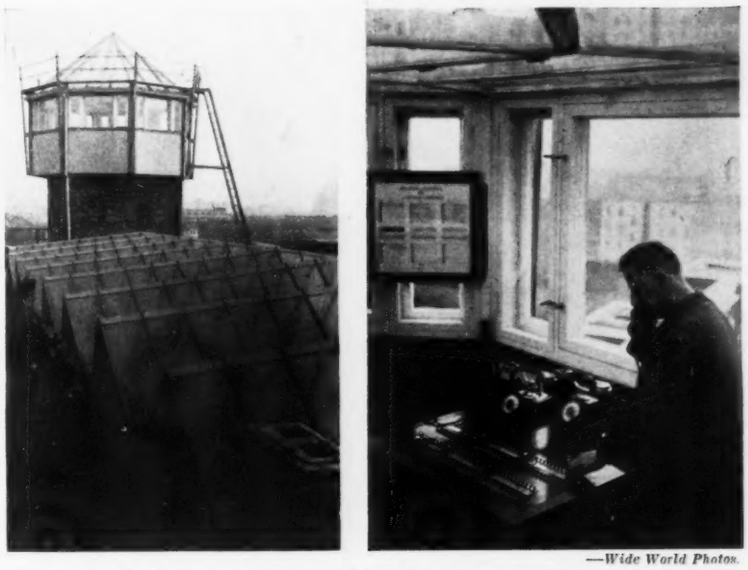
New methods of producing seamless tubing devised

Production of continuous and seamless copper or iron tubing by two new methods involving electrodeposition and said to be great improvements over similar plans were described in the paper prepared by Prof. Jean Billiter of the University of Vienna, Austria. Professor Billiter has developed one method whereby metal is deposited on a short, slightly conical mandrel to which the deposit does not adhere. The tube is moved forward at regular intervals and a new deposit formed. In the second method a low-melting hollow mandrel is slowly passed through a plating cell.

"The electric furnace is not a panacea for all foundry ills," warned William Adam, Jr., of the Ajax Metal Company, "but should receive separate consideration for each individual foundry and its own local conditions. A careful analysis of all factors will warrant the investment in an electric furnace in a great many foundries, but in other cases the reverse will be true."

Sessions were divided for consideration of electrodeposition, hydro-electrometallurgy and miscellaneous subjects. Thirty-two papers were presented covering these groups at formal sessions.

THE LIGHT TOWER OF BERLIN



—*Wide World Photos.*

A tower enabling one man, working two hours at sunrise and again at sunset, to regulate the street lighting of Berlin was recently built on the roof of an electric company workshop. The strength of the daylight is exactly measured by special apparatus

▼

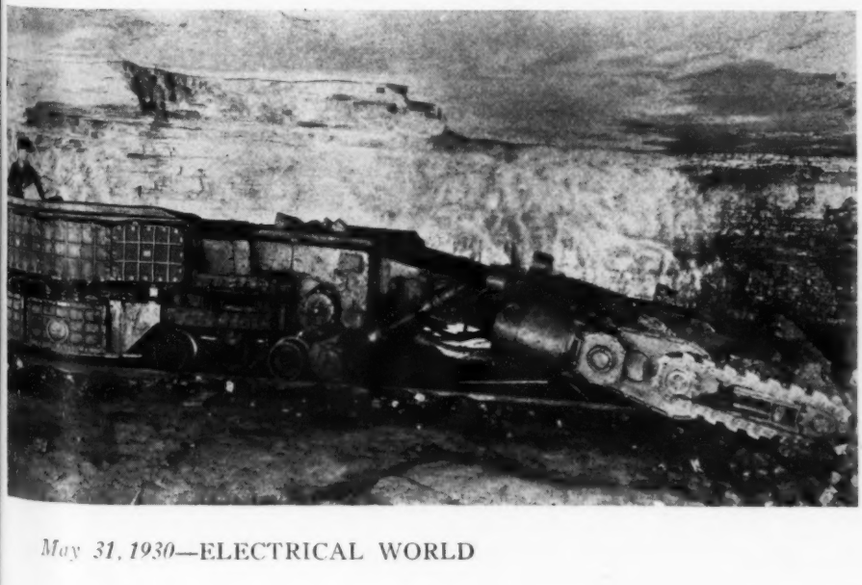
Windowless Plants Urged for Economy and Control

WINDOWLESS factories lighted by artificial means were urged by Dr. E. E. Free, consulting engineer and scientist, at the second annual illuminating conference in the Westinghouse Lighting Institute, New York.

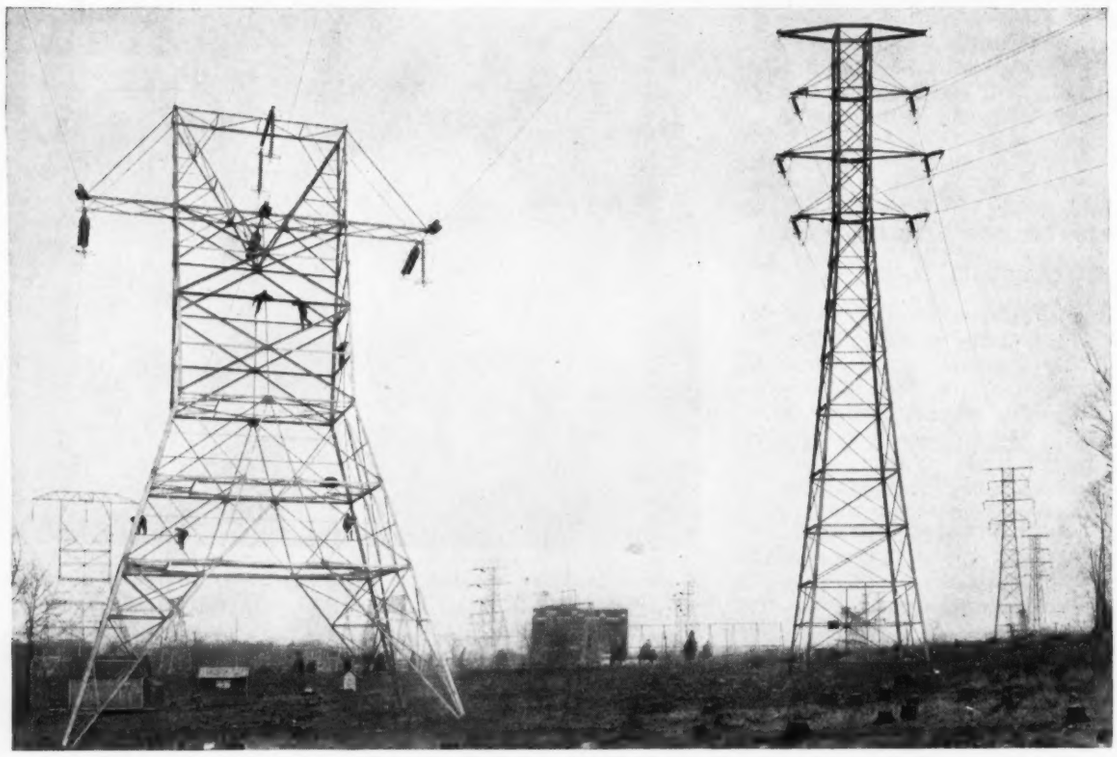
It was asserted that the omission of windows would save about 5 per cent in building costs and 40 per cent in maintenance expenses, would facilitate control of heat and circulation of air and increase the efficiency of workers. Dr. Free added:

"The lighting in a factory illuminated by daylight is changing constantly, so that only for short periods every day will each machine, desk or workbench receive that kind and amount of light best suited to the eye. Artificial lighting, however, does not mean present average daylight illumination, but from five to ten times that amount."

LARGEST COAL LOADER



ANOTHER 220-KV. INTERSYSTEM TIE NEARS COMPLETION



Finishing touches on the Roseland-Lambertville line tying in the systems of the Public Service Electric & Gas Company and Philadelphia Electric Company are being made at the Roseland end. These towers are representative of two schools of thought in high-voltage practice. Roseland switching station appears in the background

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Boulder Dam Start Needs Committee Action

WHETHER Boulder Dam construction starts or not this season rests with the House committee on appropriations, hearings having ended last Friday. From all that can be gathered concerning what took place in the closed sessions, it is believed that the Interior Department has made its case against Arizona's objections and that the committee will report favorably on the requested sum of $10,660,000 to start the project. Asked how long after appropriation it would take to get the project in motion, Secretary Wilbur answered, "Five minutes."

▼

Canadian Power Company Incurs Commons Wrath

A STRONG attack on the alleged "methods" of the Beauharnois Light, Heat & Power Company and the Beauharnois Power Corporation, Ltd., was launched by members in the Canadian House of Commons last week. The company's power canal project on the St. Lawrence River was labeled as a gigantic scheme to exploit the Canadian people and the government was called upon to cancel the company's charter.

That the company and its subsidiary concerns were heavily overcapitalized was charged and the implication passed that there was an agreement between the company and the Dominion Government whereby the unallocated part of that particular section of the St. Lawrence River would be turned over to the former for exploitation. This formed the basis of a motion by Robert Gardiner, leader of the Progressive party in the House. Throughout the speeches of those supporting the motion, it was stressed that the Beauharnois corporation had obtained approval from the Dominion Government for its plan to develop 50,000 hp. in its proposed canal between Lake St. Francis and Lake St. Louis, but that the subsequent financing of the company was predicated upon the development of 1,000,000 hp.

Replying for the government, John C. Elliott, Minister of Public Works, declared emphatically that there was no agreement between the federal government and the power interests in regard to further exploitation of water powers by the company. He pointed out that the jurisdiction of the federal authorities was confined solely to a consideration of the plan in the light of the provisions of the navigable water protection act. The lease to the power company had been granted by the government of Quebec, and any conditions regarding development or the amount of power to be developed could be imposed by that province and not by the federal government.

▼

Steam-Generated Power for Provincial Project

PUBLIC development of electric power from coal resources in the province of New Brunswick will become an actuality under the plans of the New Brunswick Power Commission. The commission has been authorized by the provincial government to proceed immediately with the establishment of an electrical power plant in the Grand Lake area, near Fredericton. There power in large quantities suitable for industrial purposes will be developed by burning the bituminous coal in which

the district abounds. The plant, which will be established at the mine heads, will burn pulverized coal. The area has reserves estimated at about 70,000,000 tons.

The plant is to have a capacity sufficient to take care of all the power and household requirements of York, Sunbury and Queens counties. It is believed that the prospective development will provide the central section of the province with power for the farms and for industrial and other purposes. The Power Commission has announced that the Maritime Electric Company, subsidiary of the Associated Gas & Electric Company, at present supplying the Fredericton district with power, has agreed to cut its rates to meet the Grand Lake development when the latter is completed.

▼

Indiana Interests Prepare to Fight Kw.-Hr. Tax

PROPOSED special tax levies in Indiana, amounting to ½ cent on each kilowatt-hour of electricity generated or sold in that state, will be vigorously opposed by utility and business groups. This was indicated at the most recent session of the Indiana tax survey commission. Action by the Indiana General Assembly has been considered.

In a brief submitted by John C. Sawyer, an attorney for the Insull interests, and Glen Van Auken, an Indianapolis utility attorney, it was stated, in part:

"There is only one way to lessen the tax burden, and that is to levy less. Why not try economy? Why not do as any individual or business would be compelled to do under the circumstances—cut down expenditures?"

It was stated that there is no good reason for giving the state tax board jurisdiction over utilities and banks and not over other corporations. Either the state board should have jurisdiction over all corporations or all should be assessed locally, it was contended.

Tax on power seen as industrial catastrophe harmful to whole state

"Imposition of the kilowatt-hour tax would add to the customers' bills and would result in barring industries from the state, as well as force present companies either to move out or generate their own power. The electrical utilities companies in Indiana now are paying from 20 to 35 per cent of their income for taxes."

The Indianapolis Chamber of Commerce, at the hearing, announced its intention of fighting the proposed legislation, which, if passed and declared constitutional, would have a far-reaching effect in other states. Its brief stated in part:

"The proposed tax would add a very large burden to most business concerns, increasing the total tax bill of many by from 25 to 40 per cent. It would, in effect, increase the cost of electric power by from one-third to one-fourth to large users of power. To a great many industries this would be such a large increase in cost of production as to be disastrous."

▼

Non-Utility Protection Seen as Consumer Menace

THE Oregon regulatory practice which provides protective privileges to industries other than those actually engaged in the electric business should be discontinued, in the opinion of Public Service Commissioner H. H. Corey. In the substantiation of his contention relative to the doubtful service usually obtainable from operators who deal only in surplus power, Mr. Corey cites the application of the Brookings Lumber Company for authority to discontinue an electric light and power service being rendered by it in the town of Brookings. The department was obliged to allow the application on the ground that the lumber company had ceased operations and desired also to withdraw from the electrical field.

"Probably the most objectionable feature connected with this particular phase of regulation," states Mr. Corey, "are the delays and backwardness of permanent electric development which invariably result in those communities depending upon service from lumber mills or other industries which generate power for their own use and peddle out any surplus energy developed over and above their own needs. It is seldom, if ever, the intent or desire on the part of these industrial operators to establish what is termed in public utilities practice a 'permanent and adequate service,' but as long as they continue to serve their customers in a more or less adequate degree this commission is required by statute to prohibit any other electric utility from entering the field."

▼ ▼ ▼

WELDED BUOYS APPROVED BY GOVERNMENT

Ewing Galloway

Construction of elements for channel buoys is now done by electric welding at the Staten Island, N. Y., supply base of the United States Lighthouse Service. Stronger buoys and reduced maintenance are among the advantages realized.

New Jersey Public Service Plans $50,000,000 Station

A NEW generating plant to be erected at the cost of $50,000,000 on property now owned by the city of Burlington, N. J., with an initial installation of two 60,000-kw. turbo-generators, is planned by Public Service Electric & Gas Company. At least three more units of equal capacity would be eventually installed. With all five units in operation the total capacity of the Public Service system would be increased by approximately 60 per cent. Negotiations with the city are reported to have been opened and construction will probably be started at an early date.

The new plant would not only serve the southern section of the company's territory but its output would be transmitted over the company's lines to serve its northern New Jersey properties.

The reason for the company's intention to build a new station at Burlington is attributed to the rapid development not only of Camden, Gloucester, Burlington and Mercer counties, but to the increasing demand for electric service in Public Service territory.

The electric department of the Public Service Electric & Gas Company recently purchased 38 acres of land in Pensauken Township, Camden County, N. J., for the erection of a large switching station for the Camden district. The erection of this plant is part of the electrical development program of the Southern division of the company.

▼

Missouri Commissioner for Holding Company Powers

THAT the Missouri Public Service Commission should be empowered to deal with the new problems of supervision of utilities created by holding companies was the contention of Milton R. Stahl, chairman of the commission, in a recent address in St. Louis.

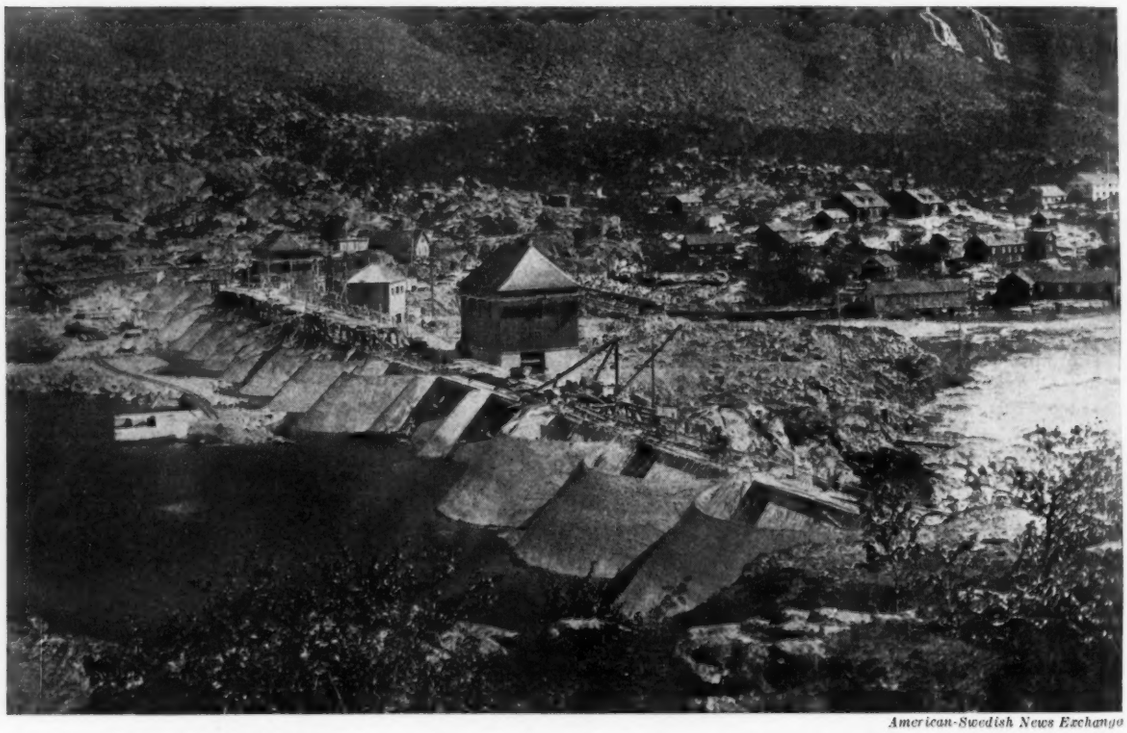
"I believe that the powers of the Missouri commission should be enlarged in accordance with the recommendation of the New York commission on the public service commission law," said Mr. Stahl. "The commission should have the right to examine the books of holding companies in regard to operating expenses of separate utilities controlled by the holding company and should be authorized to refuse to allow as operating expenses the purchases made by the holding companies unless previously approved. In some cases the holding companies have paid excessive prices for the properties they acquired and have sold securities in excess of the properties' value. Some of these holding companies have failed, and in other instances the financial difficulties of the holding companies have made it difficult for the individual utilities to obtain capital necessary to operate successfully.

"It should be the policy of the utility holding companies to conduct their business so that the public will become convinced of their honesty. If they do not do so, unwise and unintelligent legislation is apt to result.

"There is one aspect of the holding company problem which state commissions cannot handle and which the law can give them no power to deal with. That is the security issues of holding companies. On account of changed conditions state commissions cannot protect the public against such abuses and the state cannot confer power on them to control the security issues of foreign holding companies. If a remedy is necessary, it must be through some federal agency."

▼ ▼ ▼

RICH IRON ORE DEPOSITS MADE AVAILABLE BY ELECTRICITY



American-Swedish News Exchange

One hundred miles north of the Arctic Circle in Swedish Lapland, at Kiruna, are iron ore deposits said to be the richest in the world. Ore averages 60-70 per cent pure metal and deposits are over one-half mile deep. The development of hydro-electric power for mining and railway transportation use has opened this field to successful exploitation after 200 years of repeated failures. The dam shown under construction is that at Suorva, Lapland, which now holds in reserve some billion cubic yards of water for the project

Lackawanna to Operate Electrically This Fall

RAPID progress in the erection of catenary structures and substations, as well as in the fabrication and rebuilding of rolling stock is being made by the Delaware, Lackawanna & Western Railroad Company toward the electrification of its eastern terminus and suburban lines (ELECTRICAL WORLD, page 704, April 5, 1930). The present expectation is that the first electrified trains will be placed in operation some time in the early fall. Substantially complete electrified service will probably be in operation between Hoboken and Montclair, Dover and Gladstone, by January 1, 1931.

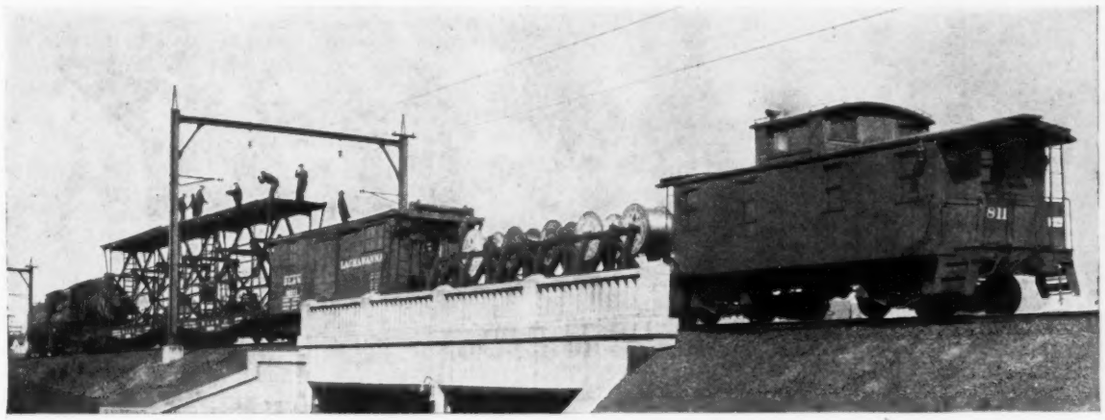
Organized erection plan calls for seven trips of special train

At present 92 per cent of the concrete foundations for the catenary system are in place. About 75 per cent of the total of 4,000 tons of steel for overhead bridge support is in position. Of the 903 miles of copper and bronze wire and cable to be used more than 20 per cent has been strung.

Setting up the overhead wiring system proved a complicated and specialized job. Wire gangs cover the line seven times in completing the system. On the first trip the insulators and brackets are attached to the overhead bridges; on the second trip the signal wires are strung; on the third trip the main messenger cable; on the fourth trip the hangers for the auxiliary messenger wires are spaced and attached; on the fifth trip the auxiliary messenger wires and the contact wires are strung; on the sixth trip the clips or fastenings which hold the contact wires in position are attached, and on the final trip the entire wiring system is given any necessary adjustments.

It has been found that in this way quicker work and a better job result than if attempt is made to complete the entire installation in one or two trips. The five substation buildings are completed and, considered as a whole, the installation of the conduits, rectifiers, transformers and other electrical paraphernalia is about 40 per cent completed at the present time.

This being the first suburban electrification project of importance in America which does not follow a relatively level course, somewhat more power will be required to propel the same weight of train at the same rate of speed over the grades. Accordingly, Lackawanna electrical engineers and those of the General Electric Company have co-operated in the production of an entirely new type of motor for the motor cars, to provide the requisite power. The first motor car has been shipped for the installation of the first motor, after which it will be put through any pace which it ever could possibly have in service.



Special train making seven trips speeds Lackawanna electrification construction

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Great Lakes N.E.L.A. Elects New Officers

AT THE annual meeting of the conference delegates of the Great Lakes Division, N.E.L.A., held in Chicago, the following officers were elected to take office on July 1, 1930: Eugene Holcomb, president Consumers Power Company; L. B. Andrus, vice-president Indiana Electric Corporation; John G. Learned, vice-president Public Service Company of Northern Illinois; S. B. Way, vice-president Milwaukee Electric Railway & Light Company, and Tom C. Polk, secretary-treasurer, 20 North Wacker Drive, Chicago, Ill.

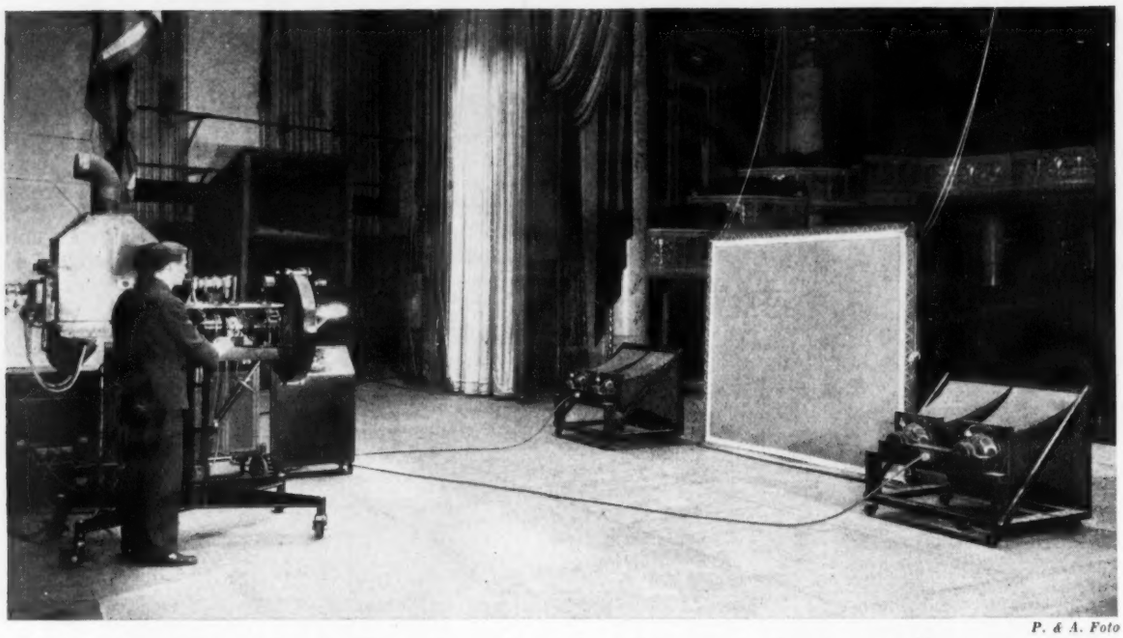
California Organization to Unify Industry Groups

TO INCREASE the operating efficiencies and economies of various promotional organizations of the electrical industry in California, unified direction of the work of these groups is to be effected by bringing them under the control of a permanent organization representative of every branch of the industry. The name of the organization has not been decided upon. Activities thus to be co-ordinated deal directly with the commercial or business-building phases of the industry as represented by the Pacific Coast Electrical Association, California Electrical Bureau, the co-operative magazine advertising campaign, the Committee on the Relation of Electricity to Agriculture, and radio broadcasting.

The California power companies, the manufacturers, the wholesalers and the electrical contractor-dealers are represented in the organization by two members from each, a ninth member represents the technical press, and in addition, the first vice-president of the Pacific Coast Electrical Association shall each year be an ex officio member of the committee.

Personnel of the co-ordinating committee: W. L. Frost, Southern California Edison Company, Ltd., chairman; R. M. Alvord, General Electric Company, San Francisco; G. E. Arbogast, California Electragists, Los Angeles; H. H. Courtright, Valley Electrical Supply Company, Fresno; R. E. Fisher, Pacific Gas & Electric Company; A. M. Frost, Great Western Power Company and San Joaquin Light & Power Corporation; D. E. Harris, General Electric Supply Corporation, San Francisco; H. L. Harper, Graybar Electric Company, Los Angeles; A. E. Hitchner, Westinghouse Electric & Manufacturing Company, Los Angeles, and G. C. Tenney, *Electrical West*, San Francisco.

LIFE-SIZED IMAGES ACHIEVED IN TELEVISION



P. & A. Foto

Old limitations fall once more! The entire audience in a Schenectady theater was able to see and hear distant performers in life size when their images were imposed on this 6 x 7-ft. screen in a television demonstration last week. Dr. E. F. W. Alexanderson of the General Electric Company predicts wide use in peace and war

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Scientific Regulation Is Best, Sloan Contends

"HOW CAN the public interest and the public needs best be served?" asked M. S. Sloan, president of the National Electric Light Association, at the meeting last week in Cleveland of the East Central Division, N.E.L.A. "By hymns of hate and political campaigns against the utilities? Or by an informed and scientific development of the laws and machinery of regulation, giving due attention to the nation's requirements for electric power and the economics of the business supplying it?

Criticism of utilities seen as centering on regulation and valuation

"The present criticism of the utilities comes down to two counts: That they have grown so great and powerful that they have outgrown public regulation and they they are making too much money, either by improperly high rates or by juggled valuations. The first count is partly true to this extent: Laws and the regulative machinery have not kept pace with the physical and economic development of the utilities. There is, so far as I know, no objection from utilities to any sane and constructive improvement in laws and the machinery of regulation.

"The second count is an error. Electric utilities—most of them—are making money. They are earning it by supplying a splended service, usually at declining prices, increasing their sales so largely that lowered rates still yield a good margin of revenue over expenses. Many of them do not charge enough to earn what is usually considered the legal rate of return on valuations provable according to the conditions laid down by the courts.

"It has become the fashion with a certain group of people, some of them public officials, to hold electric utilities up as plunderers of the public. The fact is that they have a record of improved product—that is, their service—and decreased prices second to no industry I know of in the realm of business."

Engineering and sales promotional features emphasized

A world view of engineering problems was presented to the convention by E. C. Skinner. Frank F. Fowle discussed inductive co-ordination as a business problem, and Paul S. Clapp presented in his address a national picture of the accomplishments and present status of electric utilities in relation to the political and other forces now acting upon them. The engineering section of the division was represented on the program by A. E. Grunert, discussing trends in generation station design; H. G. Nichols, who spoke on the load center of the home, and P. B. Juhnke, who described the administration and operating routine of the Chicago power pool.

New officers of the association elected in Cleveland are: President, C. H. Hardesty, vice-president Monongahela West Penn Public Service Company; vice-presidents, G. E. Miller, Cleveland Electric Illuminating Company; C. L. Proctor, Lake Shore Power Company, and C. E. Torrey, Ohio Power Company.

An attendance of 1,100 was registered.

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N.E.L.A. Discontinues Issue of "Rate Research"

RATE research instituted in 1912 by the National Electric Light Association as the medium of publishing promptly decisions of state commissions and courts, together with miscellaneous references on public service matters, has been discontinued. The field, according to an official announcement, is now generally covered by other publications furnishing similar service available to members and others, and in view of this fact it has seemed to those authorized to act in the matter that the duplicated service is no longer essential. It is, however, proposed to continue or expand the less technical summaries of important rate decisions recently incorporated in the monthly *N.E.L.A. Bulletin*.

New York Project Combines Power and Stream Control

THE new 30,000-hp. Elmer J. West hydro-electric station at Conklingville, N. Y., has just been completed by the New York Power & Light Corporation. Located below the dam of the Sacandaga reservoir of the Hudson River regulating district this station is provided with two 12,500-kva. water-wheel-driven generators. The project serves both for power supply and stream control.

The artificial lake erected by the damming of the Sacandaga River is approximately 25 miles long and 5 miles wide, making it probably the largest artificial body of water in the East. About 273,000,000 gal. is impounded. Three hamlets entirely disappeared and portions of nine others were submerged in this project.

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Coming Meetings

American Society of Mechanical Engineers, Hotel Book-Cadillac, Detroit, Mich., June 9-12. Calvin Rice, 33 West 39th Street, New York, N. Y.

North Central Division, N.E.L.A.—Managerial Section, Alex. Johnson Hotel, Rapid City, S. D., June 11-12. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

Canadian Electrical Association — Manor Richelieu, Murray Bay, Que., June 11-13. H. M. Lyster, 405 Power Bldg., Montreal.

Pacific Coast Division, N.E.L.A.—San Francisco, June 16. S. H. Taylor, 447 Sutter St., San Francisco.

National Electric Light Association—San Francisco, June 16-20. A. J. Marshall, 420 Lexington Avenue, New York.

Association of Iron and Steel Electrical Engineers — Broadway Auditorium, Buffalo, N. Y., June 16-20. John F. Kelly, Empire Building, Pittsburgh, Pa.

World Power Conference—Berlin, Germany, June 16-25. O. C. Merrill, Edmonds Building, Washington, D. C.

Wisconsin Utilities Association — Accounting Section, Eau Claire, June 19 and 20; Electric Section, Lorain Hotel, Madison, July 17 and 18. Commercial Section, Green Bay, July 31 and August 1. J. N. Cadby, 105 Wells St., Milwaukee.

American Electric Railway Association—San Francisco, June 21-26. Guy C. Hecker, 292 Madison Ave., New York.

American Institute of Electrical Engineers—Summer convention, Toronto, June 23-27. F. L. Hutchinson, 33 West 39th St., New York.

American Society for Testing Materials—Haddon Hall, Atlantic City, N. J., June 23-27. C. L. Warwick, 1315 Spruce St., Philadelphia.

Camp Co-operation X — Association Island, Henderson Harbor, N. Y. August 8-12. Society for Electrical Development, 420 Lexington Ave., New York.

Association of Electragists International—Hotel Schroeder, Milwaukee, August 18-20. L. W. Davis, 420 Lexington Ave., New York.

International Association of Electrical Inspectors—Northwest Section, Bellingham, Wash., Aug. 25-27. F. D. Weber, 414 Lumbermen's Bldg., Portland, Ore.

STOCKHOLM HARBOR AFTER NIGHTFALL

Illumination of the City Hall of Stockholm, Sweden, streaks the harbor. Scandinavian power is largely from hydro-electric sources

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World Power Speeches in Listeners' Language

A REMARKABLE and perhaps epoch-making innovation in the reception of speeches at international gatherings will be tried out at the meeting of the second plenary World Power Conference in Berlin next month. It will be possible to follow addresses and discussions in any of the three official languages of the conference, English, German, or French, no matter which of these languages is being used by the speaker.

Placed in front of each seat in the auditorium will be a pair of headphones, connected to a specially designed switch box by means of which the listener can switch in to the language he best understands. In addition, a volume control is included.

The speakers and the interpreters, who translate on the spot, will all speak into microphones equipped with soundproof mouthpieces. In order to show which language may be heard at any given time, an indicator is arranged behind the speaker's rostrum with colored lamps which light up in accordance with the languages in which the speech is to be transmitted.

In addition to the three official languages, two other languages can also be used if necessary. Since the original speaker himself also speaks into a microphone, whereby his words can also be heard by means of the head-phones, every member of the audience may listen in to any of six languages.

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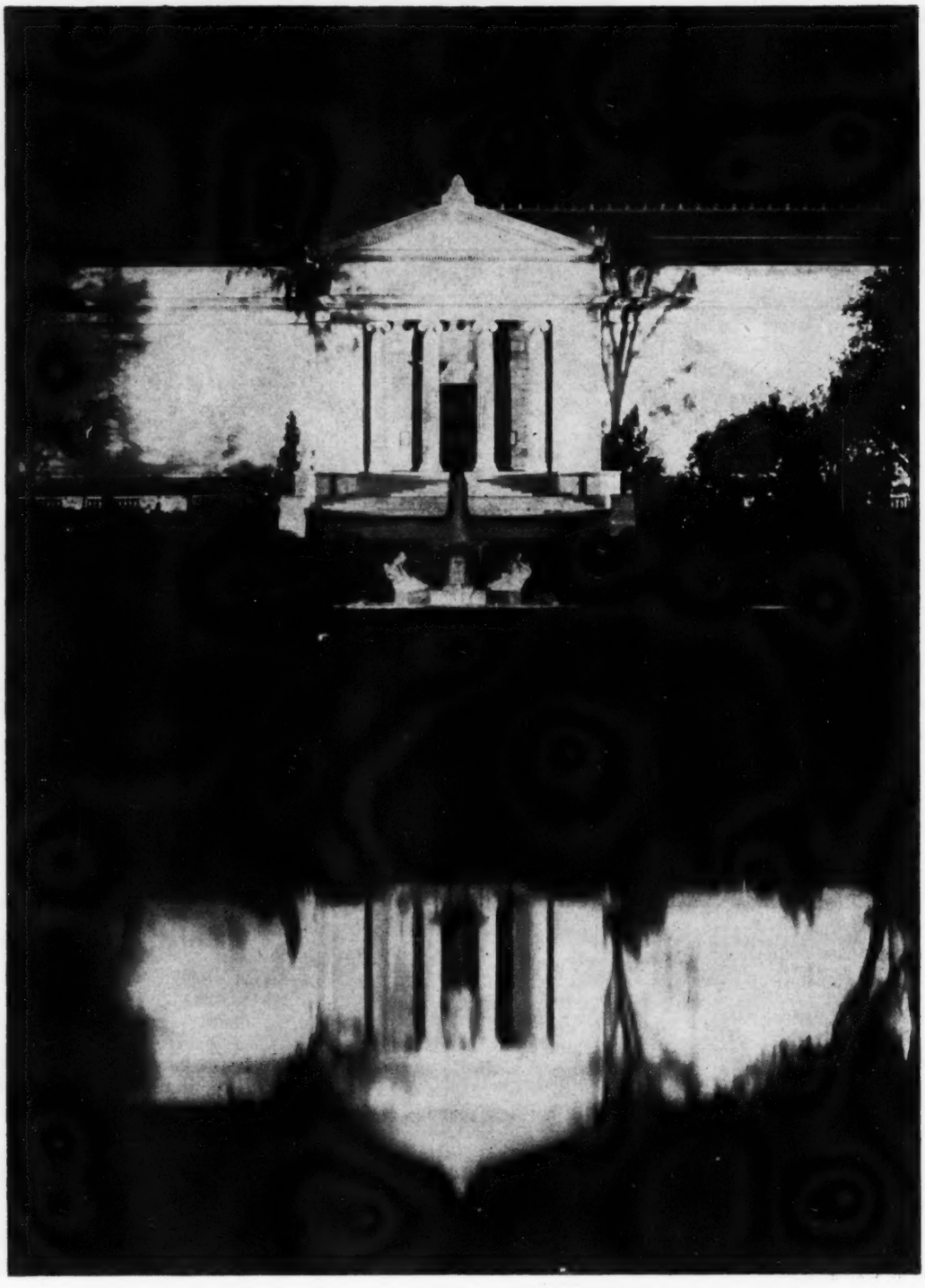
North American Hearings Indefinitely Postponed

FEDERAL Trade Commission examination of the North American Company's group of public utilities, previously set for May 27, has been indefinitely postponed and probably will not be held until next fall. According to the commission's statement, the company has co-operated fully in producing records. Delay is due to the great bulk of work devolving on the government examiners and accountants who have not been able to put their finding on the North American Company in shape for a hearing at this time.

The affairs of two other electric companies as yet unnamed will be investigated during June. Inasmuch as the usual practice is to adjourn all hearings about July 1, it is understood that these companies are relatively small, since they are to be run through in this length of time. After adjournment it is expected that some steps will be taken by the legal staff to clear up the Bond & Share court case, still pending the appointment of a special master by the New York District Court.



ARTIFICIAL MOONLIGHT—

A utility's gift to Cleveland

THE avoidance of harsh contrasts and high intensities of illumination add mellow softness to the permanent "moonlighting" of the Cleveland Museum of Arts. The Cleveland Electric Illuminating Company assumed the entire expense of design, installation and upkeep of the necessary equipment.

EDITORIALS

L.W.W. MORROW
Editor

Interconnection Contracts and Rate Cases

INDUSTRIOUS lawyers engaged in prosecuting rate cases against power companies are always hunting for examples of apparent extravagance in utility management. A major objective of these protagonists of argumentation is to show, if possible, that a company has spent too much money either for plant or in its operations, from which it is deduced that net earnings are too high to justify the rates charged for service.

A sub-target in this kind of fusillade is the apparent comparative cost of purchased power against the apparent cost of company production. If the legal talent lined up against the utility can make it appear that the average rate per kilowatt-hour purchased over a stated period is higher than the manufacturing cost in the company's own generating plants, also averaged over a substantial time, it is then made to appear that the "power barons" have wasted their substance in riotous corporate living. From this it is argued that net earnings are higher than they appear and that rates should be correspondingly reduced.

Interconnection contracts viewed from this angle need not cause anxiety, if such agreements are conceived in honor and brought forth with the single purpose of improving service and effecting savings when all costs involved are considered. The haphazardism of averages is a pitfall which the utility manager should easily be able to avoid in explaining the value of such agreements to the parties concerned and to their customers. It is hard for some of the brethren of the bar to appreciate the difference between primary and secondary purchased energy, or to grasp the fact that a kilowatt of capacity available on a system on the peak may be worth far more than the same amount of power supplied at another time. One cannot judge an interconnection contract by either kilowatt-hour or kilowatt yardsticks alone. Increment costs are little understood by many followers of Blackstone until long and arduous instruction has been applied and absorbed. Then, too, generalizations as to the over-all period average cost of delivering energy are fraught with difficulties for the less experienced attorney.

The plain lesson of these matters is to be prepared at all times to show to the satisfaction of competent engineering judgment that interchange contracts are soundly built from the economic and service standpoints.

Lift the Economic Curtain

WHICH lines pay and which do not? Which lines are in the economic twilight zone? Have unexpected changes in load modified the situation from the viewpoint of revenue? Do comparisons of load curves over particular periods indicate that an undue amount of idle investment is being tied up in this or that line? If so, what can be done about it at justified cost? Does the operating company rely upon an annual (?) survey of transformer loadings before admitting the necessity of a change of conductor size and perhaps of voltage and insulation, and after making such an admission does the manager "kid himself" with the comforting thought that he can make the old line "hold the bag" for one more peak-load season before going to the directorate with a request for a betterment appropriation?

It does not take much imagination even when passing such a line at a good many miles per hour to see behind its apparently staid usefulness and settled reliability an opportunity to do some very profitable analyzing. The responsibility is, of course, not that of the passerby, but if more men who operate local properties would occasionally scrutinize their outdoor plant from this detached angle, the results of such a critical attitude would occasionally be most profitable.

N.E.M.A. Meeting Promising

MORE than 450 electrical manufacturers met at Hot Springs to discuss their affairs. The general sentiment was that sales for this year would be from 8 to 10 per cent less than last year and, since last year was above normal, this volume of business was not looked upon as particularly depressing. The general business situation is thought to be about stationary, but a pick-up is anticipated in the fall.

The National Electrical Manufacturers' Association has come to be a unit group, embracing nearly all manufacturers of electrical products. It voices the opinions and deals with the problems of this group in industry and makes possible unity in manufacturer co-operation with other industry groups. It is a young organization, but has already made a place for itself in industry councils.

At the Hot Springs meeting standardization and what might be called the educational aspects were accented. All lines of electrical products offer opportunity for simplification and standardization and the sections of N.E.M.A. are still busy at this work. In the larger aspects of the manufacturing situation, trade practices, statistical studies of markets, cost accounting, specifications, labor and other current topics always need to be discussed each year. The place of the large and small manufacturer in the electrical industry needs to be fixed more definitely. Evidence accumulates that the small manufacturing business, when conducted intelligently, is a needed and profitable enterprise.

These internal problems were adequately treated at the Hot Springs meeting. But certain larger industry topics and opportunities were neglected. The manufacturers are one of several groups in the electrical industry; they, as well as the others, depend upon the development of electrical markets for success and must team with other units to establish agencies for developing the markets economically. In this realm of sales and distribution the N.E.M.A. convention should contribute something to industry action or thought. It would seem advisable to have one or two general meetings devoted to industry objectives in market development and to industry co-operation in sales. The new situation with respect to jobbers, the trends in utility merchandising, the use of co-operative advertising, industry joint sales programs, dealer sales organization for economical distribution and many other basic industry topics should receive the attention of the manufacturers at their meetings. The manufacturers should present their point of view and hear the points of view of other industry groups. This will make for unity in industry action toward greater national electrification.

Service Restoration Hampered by Switching Complications

HARDLY a district in any of the large systems depends for its energy supply on a single circuit or even a single transmission line. At least two ways of supplying it are usually provided; as a rule three or more. Still, it occasionally takes some companies one-half hour to restore service after the failure of a transmission line. Is this delay incurred because the interconnections are so complicated that an operator has to do a great deal of thinking before changing over a connection? Are the various combinations of ring buses, loops, bypasses and transfers confusing to the operator who must restore service? Is it necessary for operators to make a trip to the outdoor switchyard to select the disconnects which must be operated, and is he greeted there by a forest of disconnects, in which he may easily select the wrong ones? Is it because of faulty communication facilities?

The ideal system would be one which aims to have all its circuits diagrammatically the same, so

that an operator does not have to remember more than one circuit. In many instances it should not be necessary to do any bus switching or synchronizing when it is desired to throw a district over quickly from one source of supply to another. Often the transfer can be made without disconnects, or if disconnects must be used for the purpose, they can be electrically operated from the switchboard. As soon as a district is put in operation on one source of supply the operator should check up at once and determine what he would do if this source failed. In some instances he might close all disconnects on the next source and have everything in readiness so that an emergency transfer can be made by merely closing one control switch.

The reduction of outage time is an essential consideration in engineering design, and if it is so considered there is apt to result a simplicity and reliability that reduces costs as well as outages. It is not so much a matter of duplicate facilities as it is of time required to transfer sources and feeders.

Substitutes for Steam

POWER generation and heat transfer efficiencies might well be improved by the use of substitutes for water. Mercury was the first to be tried and has proved acceptable under certain conditions. The latest additions are diphenyl and diphenyloxide. These are hydrocarbons with interesting characteristics and can be made cheaply and in volume if the demand is created.

Diphenyl is a solid at ordinary temperatures with a melting point at 69 degrees C and a boiling point at 255 degrees C. It has no perceptible corrosive action on metals and is stable at high temperatures. At a temperature of 371 degrees C diphenyl has a pressure of only 124 pounds absolute, compared to 725 pounds for steam, and contains twice as much disposable heat energy as an equal weight of steam. Diphenyloxide melts at 27 degrees C and boils at 260 degrees C and has a critical temperature at 532 degrees C at a pressure of 520 pounds absolute.

These new elements have non-poisonous vapors and many desirable characteristics. They can be made as by-products in the petroleum industry from benzol and are worthy of study as a heat carrier, heat transfer agency and even for direct use in power generation. There is good evidence that the art of power generation is in for a new and decidedly promising development.

Rubber Insulation Challenges Further Inquiry

THERE appear to be at least one or two tests which might be added to those already proposed to yield an indication of the "quality" of rubber insulation. One test, suggested by E. W. Davis at the recent A.I.E.E. district meeting in Springfield, might be for insulation fatigue, i.e., the obtaining of data showing at what stress the insulation resistance of a cable becomes permanently reduced. It has been found that cables which have initially high values for all electrical properties are often permanently injured at much lower voltage stresses than are cables whose initial test values were comparatively low. The plotting of a "stress-strain" curve and the determination of the "electrical elastic limit" would be of some assistance in trying to predict a probable cable life.

Attempts to predict the relative life of rubber-insulated cables in service without the use of accelerated voltage-life tests are open to question. Experience has shown clearly that cables with the lowest dielectric loss and power factor or the highest insulation resistance are not always those which last longest in actual service.

A second test might be to obtain the so-called ionization factor which is present in both rubber- and paper-insulated cables. It is questionable whether it is possible today to predict the probable life of any cable under unknown conditions of service by data from only dielectric loss, power-factor and insulation resistance tests, in view of the present knowledge available upon dielectric behavior and the complex physical and chemical structures of such dielectrics. The subject is as fascinating as it is important, however, and deserves the attention it is receiving from both operating and manufacturing engineers.

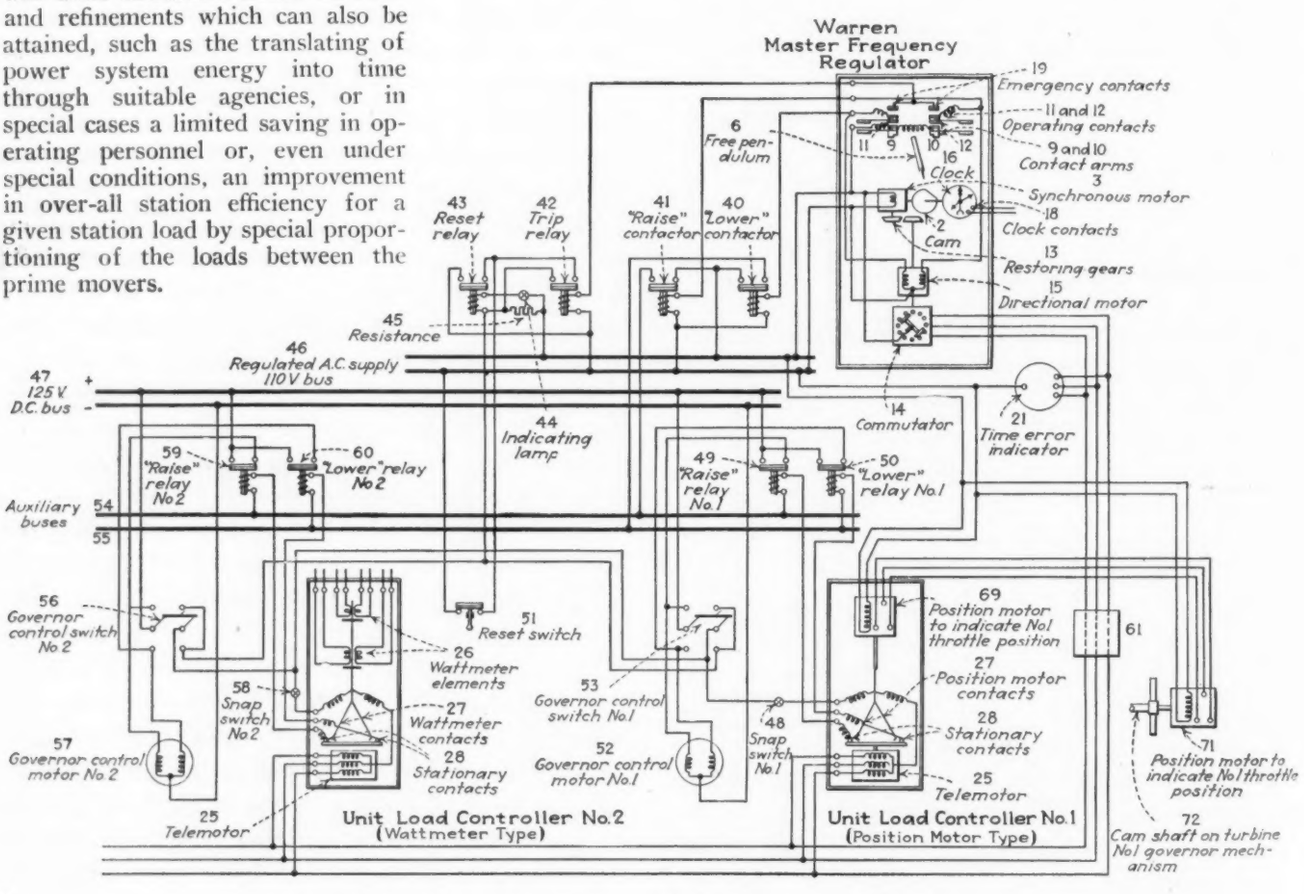
Controlling Load, Maintaining Frequency

By D. M. JONES

Central Station Engineering Department, General Electric Company, Schenectady, N. Y.

THE basic service expected of automatic frequency and load control is the furthering of the system interconnection program by reducing generating station and tie-line load changes which are normally aggravated by such a procedure. If they can be appreciably lessened the benefit to the systems will be of a major order. In the execution of this major program there will arise incidental minor services and refinements which can also be attained, such as the translating of power system energy into time through suitable agencies, or in special cases a limited saving in operating personnel or, even under special conditions, an improvement in over-all station efficiency for a given station load by special proportioning of the loads between the prime movers.

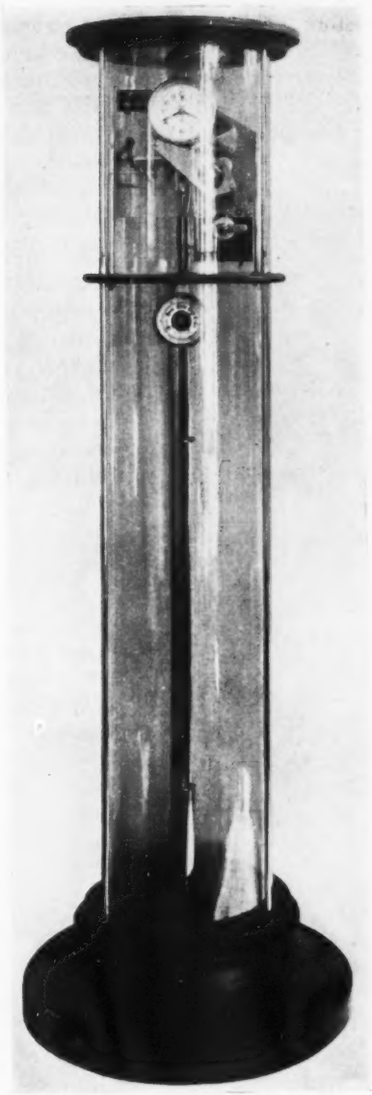
If, however, one were to select an automatic equipment primarily on the basis of one of these incidental services instead of its ability to accomplish its major excuse for existence, it would be like purchasing a pig for his squeal instead of his chops. Such romanticism, I believe, is rather denied the electrical fraternity, at least during working hours.



Schematic diagram for automatic frequency and load control

When contact 12 of the master regulator is closed as a result of low frequency, the "raise" master relay 41 is closed, energizing auxiliary relay bus 54, to which are connected all the "raise" secondary relays in the governor control motor circuits. With reset relay 43 closed the secondary "raise" relays will close, provided the respective unit load controllers are in the proper position. The closing of these relays causes the governor-control motors of the prime movers to respond to the correcting impulses, increasing the load on these machines until the unit controllers open the impulse circuit, which occurs after the load has reached the proper value. On the other hand, when frequency is high the contact 11 of the master controller closes, the "lower" master relay 40 operates and auxiliary bus 55 energizes all the secondary "lower" relays in the governor-control motor circuits and reduces the loading of the machines.

Reducing generator and tie-line load changes through automatic load and frequency control. A modern system described



Warren master frequency regulator

An accurate pendulum gives a standard for frequency and time. Correcting impulses are sent out every two seconds.

Automatic frequency control as contemplated is uniformly accomplished by checking the system frequency periodically—that is, every two seconds or so—with a standard, and then applying the necessary impulses to the prime mover governor synchronizing motors to change the prime mover throttle openings and thus correct the error indicated.

Two facts are apparent from this statement.

First—That the power system is basically on the governors of the prime movers under automatic frequency control just as it is under manual control, as the automatic device does nothing but correct the tension of the governor synchronizing springs periodically and that, of necessity, only at a certain time after the need for the correction has appeared.

Second—That automatic operation, rightly conceived, injects no sinister complexity into the problem of system of prime mover operation. It acts simply as a supervigilant operator would act, and surely vigilance in an operator is not considered a hazard to system operation.

The basic requirement that automatic frequency and load control should minimize prime mover and tie-line load changes, as far as possible, in conjunction with the fact above mentioned that power systems even under automatic control are first of all on their own prime mover governors, leads directly to the fundamentals of system operation with changes in load.

Analysis of effect of load changes on system operation

Inasmuch as the power system is actually on its own prime mover governors, each change in system load is instantly distributed over all prime movers on the system. If the governor regulation curves on all the prime movers were identical, and they are generally at least very similar, the load change accepted by each unit would be equal in per cent of its own full-load rating to the load change accepted by every other unit except as negligibly modified by the unequal shift in the voltage angle over the different power paths occasioned by the variation in the regulation of these various circuits.

This unavoidable initial distribution of the load change is thus in general as broad a distribution as could be devised. Therefore, the load change per prime mover and per tie-line should be a minimum. Without automatic control, however, the system would then find itself off true speed, and it is here that the automatic control comes into play.

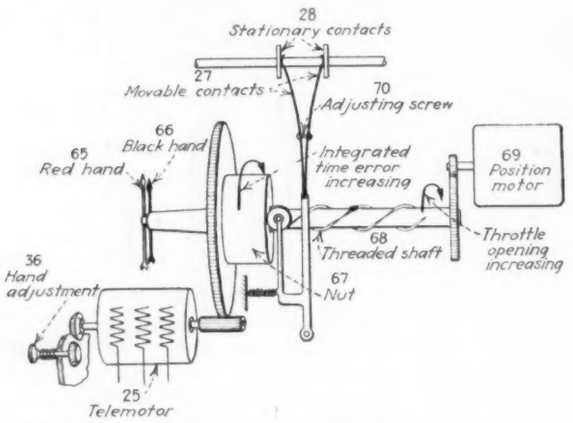
If the load change were a load increase, on the basis of the foregoing, each prime mover would pick up a given per cent of its own load rating and the load increase would be spread over the whole system, but the prime mover speeds would be correspondingly reduced by this increase in load as dictated by their governor regulation curves.

The automatic equipment would then come into play and change the governor spring tension on such units as it controlled and raise the regulation curves on these machines, which would open up their throttles until the system was back to standard frequency. This procedure would also result in the controlled machine or machines picking up the total load increase, for the uncontrolled machines would only again be back to the original frequency when they were again back to the load they carried before load increase occurred.

Thus, if one machine only were under automatic control the initial broad distribution of the load increase over all units would be destroyed and the total load increase would be routed from the place where it occurred directly to the controlled prime mover. This would not only give two successive distributions of the load increase, both on prime movers and lines, but would also tend finally to concentrate the increase both on certain prime movers and on certain tie-lines.

If, however, the automatic control were on all machines, the governor adjustment would have occurred on all machines and thus have operated to correct the frequency without further disturbance of load either on prime movers or lines. This procedure would not only

in general give a most favorable distribution of the load change but would sensibly reduce the system load adjustment period. Thus, as a general principle, simultaneous operation of many automatically controlled system generating plants evidently makes for a reduction in load change per prime mover and per tie-line for a given system load change.



Unit load controller, position-motor type

This checks the load on each prime mover in terms of operating cylinder position on turbines and gate openings on water wheels. A Selsyn generator at the prime mover energizes a corresponding Selsyn motor in the unit controller, thereby giving a positive indication of either operating cylinder position or gate opening.

If automatic frequency and load control have anything to offer, it is evidently true that it will be required to be in service continuously. In order to give continuous operation, however, two requirements must be met.

First—The system as automatically controlled must be able to handle acceptably the maximum magnitude of sudden load change (viz., kilowatts) that may at any time reasonably occur.

Second—It also must be able to change load acceptably at as fast a rate (viz., kilowatts per second) as the system load may at any time be reasonably expected to change.

Both of these demands point to a wide and simultaneous use of automatic frequency control on system generation as the simplest and most effective means of meeting the requirements. Although the reduction in load change per prime mover and per tie-line incident to this method of operation has already been mentioned, the consequences of such reductions have not been emphasized.

If the load change is held to a narrow band on all prime movers instead of to a narrow band only on some and a broad band on others, all prime movers can be operated well loaded and, therefore, not only at high efficiency but also on the flat portion of their efficiency curves. Under such conditions small changes in load have a negligible effect on these high prime mover efficiencies and the over-all efficiency of generation is improved.

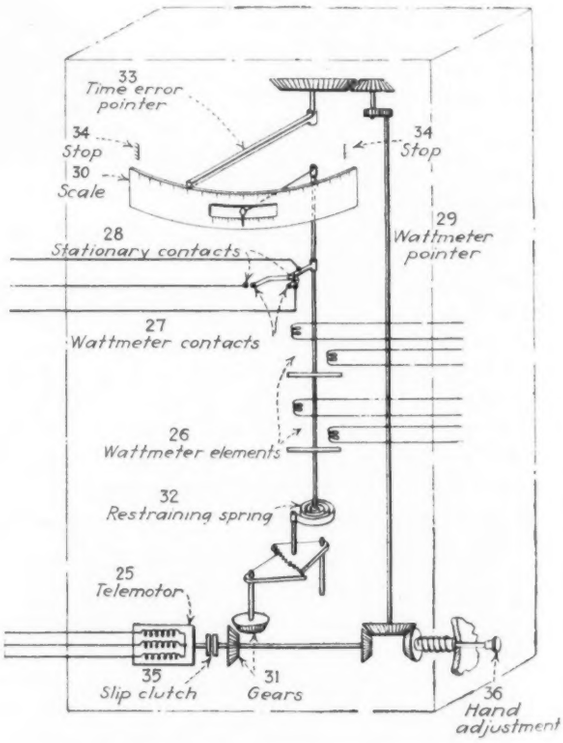
These improvements in system operating efficiency can be of major order and, therefore, not only logically supersede the minor efficiency improvements obtainable within certain stations by a special proportioning of prime mover loads within the stations, but also largely eliminate the necessity for this procedure, which is predicated primarily on the necessity of running some prime mover at light load.

This reduction in load change per generating unit will also effectively smooth out the steam demand of turbo-alternator units, much to the operating advantage of the boiler rooms, and materially reduce the pipe line surging on hydro units. Trouble has already been experienced on hydro plants due to the violation of this basic fact.

Thus, the analysis in all instances definitely indicates the decided advantage of simultaneous operation of many automatically controlled power plants in parallel. This is further emphasized by the fact that

no one station or even system will be long willing to take on the load changes necessary to control frequency for its interconnected brother plants or neighbor systems. This job is a mutual endeavor and will not prove to be accomplishable by searching for centralized, willing and easily-imposed-upon generating groups to take over the burden. Such gullibility will not long persist in the operating field.

Simultaneous operation of automatically controlled plants immediately presents the necessity of having the frequency standards in the different plants as nearly similar and constant as practicable, for changes in these standards will of themselves produce shifts in generating station output and tie-line loads. Therefore, the accuracy of the frequency standard is of prime importance. If, however, the variation between standards is sufficiently slow so that the load shift per hour is a small per cent of plant generation capacity, it will not appreciably hamper the results of automatic control, since these slow changes are not only considerably masked by



Unit load controller, wattmeter type

This checks the load on each prime mover in terms of generator watts. It dispenses with electrical connection between turbine room and operating room.

the changes which are bound to occur, due to the inherent erratic character of the system loads themselves, but, also being slow, are susceptible of periodic compensation either manual or automatic.

If, however, the error in the standard is sufficient to produce major changes in load it is evident that parallel operation will not be possible. From the foregoing it would appear that equipments with seriously inaccurate frequency standards will be totally unable to accomplish a solution of the problem.

A universal frequency standard

In considering this question of inaccuracy of standards, the ideal solution of a common frequency standard for all always arises. If each generating station could either connect to a wire network or reach up into the air and bring forth a standard frequency it would have much that was ideal about it. Its very idealism, however, makes one skeptical of its immediate attainment. Nevertheless, a remark or two concerning it may be in order.

The elimination of errors in frequency standards which are seriously inaccurate would save an equipment having such a standard from certain failure in the solution of this frequency problem.

The elimination of error in the frequency standard of a device in which the error is already small would be a refinement, not a necessity, in that device.

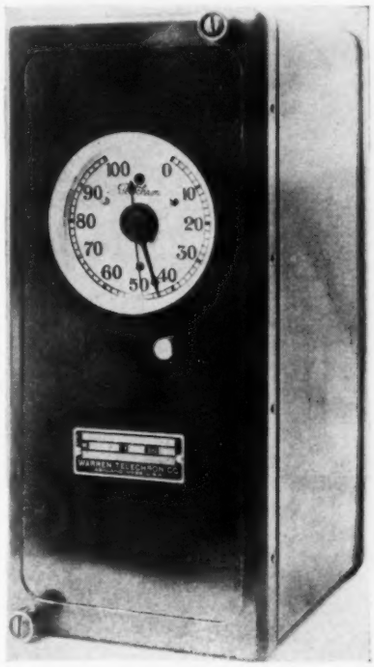
It should also be remembered in this connection that the total elimination of errors in the base frequencies will not totally eliminate either the line load shifts or prime mover load changes.

If New York were tied in with Chicago a load addition in Chicago would immediately be picked up in part by the New York generation due to governor characteristics. This, of course, means tie-line load change and a load change on New York units. Therefore, both prime mover and tie-line load shifts, under automatic control as now contemplated, will be a composite resultant of frequency-base errors and system load changes, and even if these changes were reduced to those incident to system load changes only, it is possible that the necessary periodic manual or automatic adjustment of the automatic frequency control equipment required at one end or other of a tie-line would be practically the same with or without the universal frequency standard if the errors in the base standards were small.

Thus, it is certainly true that a common frequency is not absolutely necessary to the solution of the automatic frequency and load control problems now presented. The question is, therefore, one of how much it will cost and how much it is worth.

The basic conception of parallel operation in its full significance covers not only the common operation of several automatic control equipments, each handling a separate power plant, but also includes the satisfactory parallel operation of the different prime mover units within one station controlled by one control equipment. Satisfactory operation in this field should provide an accurate division of load between units.

It may now be of interest to examine a particular control equipment in the light of the foregoing discussion, and I will, therefore, outline the automatic frequency and load control equipment devised by Mr. Warren of the Warren Telechron Company and now being fostered jointly by the Warren Telechron Company and the General Electric Company and marketed by the latter. This equipment for controlling a generating station consists essentially of one frequency error indicator for the station plus one unit load controller per prime mover in the station. In the frequency error indicator the frequency of the power system is reduced to motion by running a Warren synchronous motor directly from the system power. This motion is then checked against the beat of a free seconds-pendulum. This check is made once every two seconds and the error translated into an electrical impulse of a duration proportional to the displacement between the pendulum and the member operated by the synchronous motor.



Exterior view of position-motor type of unit load controller

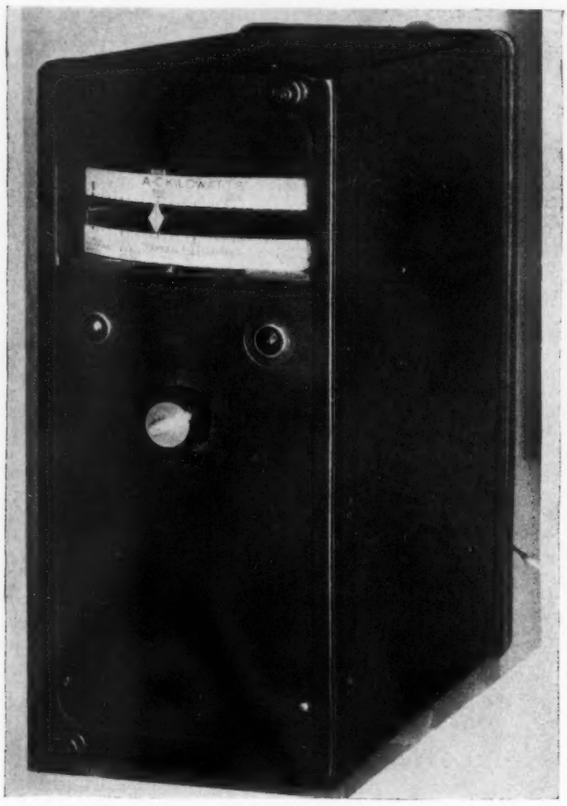
In making this check between the motion of the pendulum and the synchronous motor the comparing device, which is driven by the motor, also imparts the necessary periodic energy to the pendulum to keep it oscillating at practically a constant amplitude. These factors constitute the justification for speaking of the pendulum as a free pendulum.

This electrical impulse energizes a small motor which drives a position generator (the equivalent of a Selsyn generator) through an angular displacement proportional to the duration of the impulse. This position generator then transmits this angular displacement through gears back to the motion-checking mechanism, realigning it with the pendulum so that they are again in phase, and also through electrical connections to position motors (similar to Selsyn motors) transmits the same identical angular displacement to the unit load controllers, one of which is connected to each prime mover under the control of the equipment. Thus the realignment correction in the master frequency error indicator and the motion of the "indicated-error-hand" on each unit load controller are positive and equivalent, for they are meshed together by either mechanical or electrical gears.

To each unit load controller the output of the prime mover to which it is connected is also transmitted in terms of displacement, and thus by means of the standard follow-up principle the kilowatt output of each controlled prime mover exactly follows each "indicated-error-hand." Now as these hands, as shown above, are all effectively geared together, the outputs of the prime movers in following will also bear a definite relationship to the error indicated between pendulum and system.

Reference to accompanying illustration will show the principles involved in the unit load controller mech-

anisms and will also bring out the fact that this device exists in two types, one in which the prime mover output is translated into motion through a standard watt-meter element and another in which the motion of a gate or valve on the prime mover is considered to represent prime mover output and the position of this gate or valve



Wattmeter type of unit load controller

is then transmitted to the controller by a standard Selsyn generator-motor couple.

It is evident also from the foregoing that the comparison of displacement between the synchronous motor-driven mechanism and the pendulum is not a comparison of the rate of speed of the system with a standard rate of speed, but a comparison between the totalized revolutions of the system, which is the same as integrated cycles-per-second or time, with the beat of a pendulum which is also time. The automatic device thus operates to proportion the load on the generating station under its control to the time error between the system and the standard pendulum.

Thus, when load is increasing on a system the unavoidable instantaneous drop in system speed incident to the addition of each load increment is not immediately eliminated by automatically running the system at over-frequency by the proper amount to compensate for it. The system is instead brought back only to standard frequency and the load added to the controlled station is proportioned to this time loss.

When load decreases on the system there is a corresponding time gain due to the rise of system frequency above normal with each increment of load decrease. These time losses with increasing load are thus neutralized by the time gains during the same load decreases and no cumulative time error occurs. This time variation is only in the order of one second lag of system behind standard for a load increase from no load to full load and is, therefore, no bar to the use of the system power for operation of time devices.

A manual reset button is provided on each unit load controller to permit manual adjustment of the "indicated-error-hand." This permits the operator manually to change load as desired on any prime mover at any time, giving him full control of the relative loading of units.

Although the normal procedure places load on each prime mover on an equal per cent basis, if it should be required to load any prime mover at some definite rate other than strict proportionality to time error it could easily be provided, as it would simply require a disproportional motion between position motor and "indicated-error-hand" on that unit load controller.

This basic equipment can be supplemented by special control to meet any reasonable operating requirement. A typical example of such additional control is a contacting tie-line wattmeter arranged to bias a frequency control equipment at one end of an interconnecting line so that the line load will be automatically returned to an acceptable value on such occasions as it may drift outside the desired limits in spite of the regulating action of the frequency control.

This type of automatic frequency and load control equipment is operating on actual systems in a manner that seems to us to vindicate the essential adequacy of its design, at least to the extent that we can visualize the demands that will be made upon it. Thus, from our standpoint the solution of this general problem of getting the maximum help from automatic frequency and load control in raising the operating performance of interconnected power systems at this moment waits on further operating experience, not on further development of equipment.

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Synchronous Motor Raises Plant Power Factor 10 per Cent

WHEN changing over from direct-current to alternating-current operation at the Arlington plant of the Du Pont Viscoloid Company, Inc., some time ago, it was decided to retain a portion of the motor load, where full-speed control was desired and a 150-kw. resistance load for process heating was involved, on direct-current supply. The power house equipment included a 300-kw. synchronous motor-generator set which was originally installed to generate a.c. or d.c. current, and thus was retained for the purpose. Recent consideration of the advisability of substituting alternating-current operation throughout the plant was largely forestalled by the knowledge that the synchronous motor was responsible for about 0.08 of the 0.75-0.80 plant power factor. As this latter consideration more than counterbalanced the combined estimated savings obtainable through alternating-current operation and elimination of losses in conversion the motor-generator set was retained.

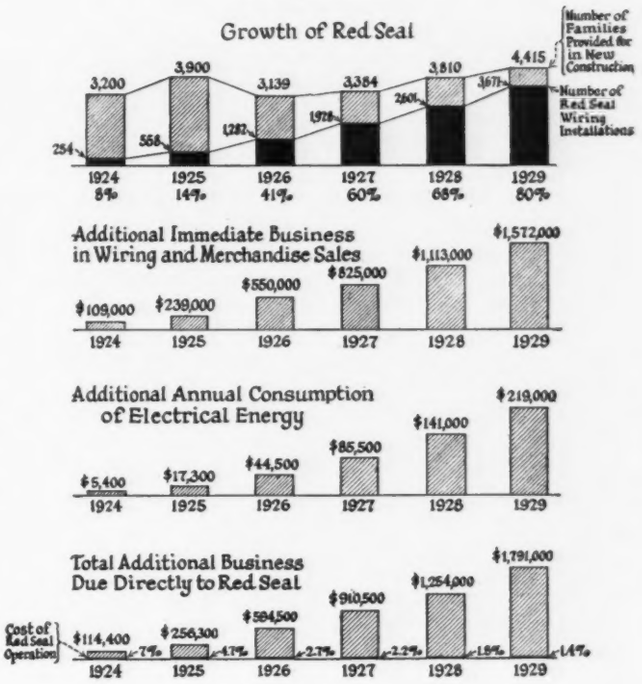
15,000 Red Seal Applications in 1929

THE Red Seal plan, which has been in actual operation for six years in Toronto and for four years in the United States, has just recently received honorable mention from the American Trade Association executives as an outstanding achievement of a trade association, in this case the Society for Electrical Development.

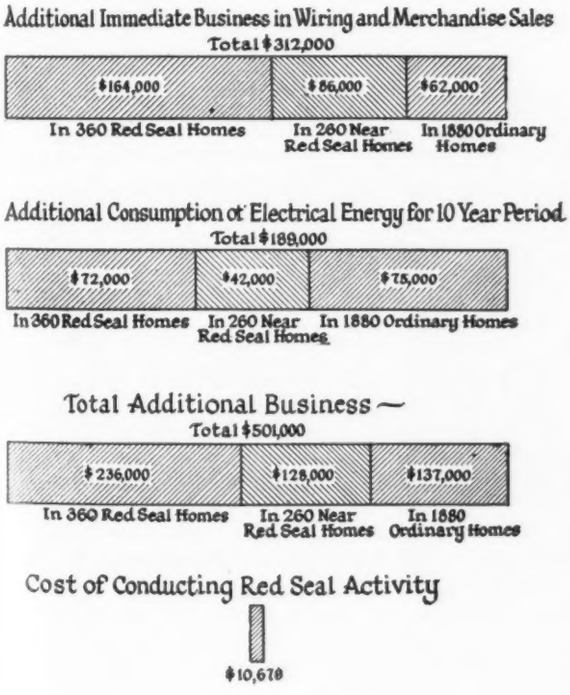
In estimating the actual return to the industry in dollars and cents, it will suffice, says Kenneth McIntyre, manager of the Society for Electrical Development, to recall the results of two outstanding local operations, one in Toronto, where an annual return to the industry of over $1,750,000 was produced at a total expense of 1.4 per cent; the other, California, which in 1929 created added business for the industry in that state at a selling expense of 2.5 per cent. The average cost of securing added business for the industry through the Red Seal plan has been approximately 4 per cent. This figure includes advertising, the general educational work and the actual assistance rendered the industry locally, in selling the prospect.

After six years of ever-increasing effectiveness, the combined electrical interests of Toronto have gained almost complete control of the adequacy of wiring installations in the new homes of that territory, Mr. McIntyre points out. The charts show the immediate return from the sale of wiring, fixtures, lamps and appliances and the annual return from the sale of electrical energy. They show only the increase in value due to the Red Seal campaign—not the total value of the home wired according

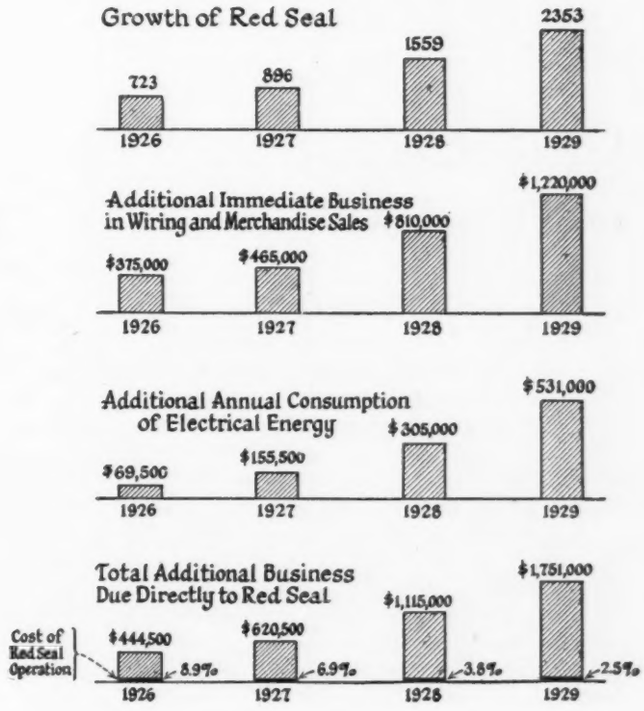
Results of Red Seal in Toronto



Increased Business From New Homes in Pittsburgh During One Year of Red Seal Operation



Results of Red Seal in California



to the Red Seal plan. This increase averages 73 per cent in merchandise sales and 126 per cent in value of electrical energy consumed.

These figures are ultra-conservative, says Mr. McIntyre, for they do not take into consideration the sale of electrical energy to these homes year after year for twenty or thirty years; that still more electrical equipment will be purchased in future, nor that the Red Seal plan affected the adequacy of wiring in the houses not qualifying for Red Seal awards and has therefore increased the use of electrical devices and energy in them.

The cost of conducting the Red Seal activity, including both advertising and selling expense, has been steadily decreasing, until last year it reached the low figure of 1.4 per cent.

Figures on the number of family accommodations provided annually in new buildings in California are not available and therefore the percentage of Red Seal wired homes to the total number erected cannot be shown. The values which are shown include no additions for the indirect effect of Red Seal, although additional data indicate that the value of this effect in California nearly equals the direct effect, Mr. McIntyre points out.

Neither has any estimate been included as to the future value to the industry of the homes already wired according to the Red Seal plan. A rapid decrease is shown in the proportion which the cost of conducting the activity bears to the value of increased sales.

It will be noted that the increased business from the "near" Red Seal homes in Pittsburgh is more than half as great as the increased business from the Red Seal homes themselves. It is impossible to state definitely just what proportion of the increased business from the ordinary homes is due to the indirect effect of Red Seal. Even if this effect were completely disregarded, however, the Red Seal plan increased business to the extent of $364,000 and the cost of obtaining this business was 2.9 per cent. If, on the other hand, the Red Seal plan is given credit for one-half the increased business from the ordinary homes, the total business was practically $500,000 and the cost falls to 2.1 per cent.

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Safety Activities on Electrical Properties*

VI—Suggestion Systems

TWENTY-TWO companies encourage employees to offer suggestions regarding the correction of unsafe practices or the removal of dangerous conditions. Employee interest in the suggestion system is encouraged by talks given by the safety engineer, by personal contact with members of the safety committee or foremen, by means of editorials in company magazines and in some cases by honorable mention, prizes or monetary awards.

In cases where purchased equipment is received without proper safeguards, it frequently becomes necessary for the employer to design and erect guards for the protection of employees. While a study of industrial accident statistics indicates that complete safeguarding of machinery effects only 10 or 15 per cent reduction in accidents, it has been found one of the most effective means of demonstrating to employees that the management is sincere in its safety work.

All companies covered by the study have adopted some method of inspecting and safeguarding machinery, equipment and tools. In some cases this duty is assigned to foremen, in others to members of the safety committee or representatives of the safety department. On some properties inspections are made by employees of an insurance carrier or agencies employed for the purpose. Thirteen of the utilities arrange that all plans for new construction will be checked by a member of the safety or engineering department or the representatives of an outside agency to determine whether proper safety provisions have been made.

*See ELECTRICAL WORLD, *April 26, May 3, 10, 17, 24.*

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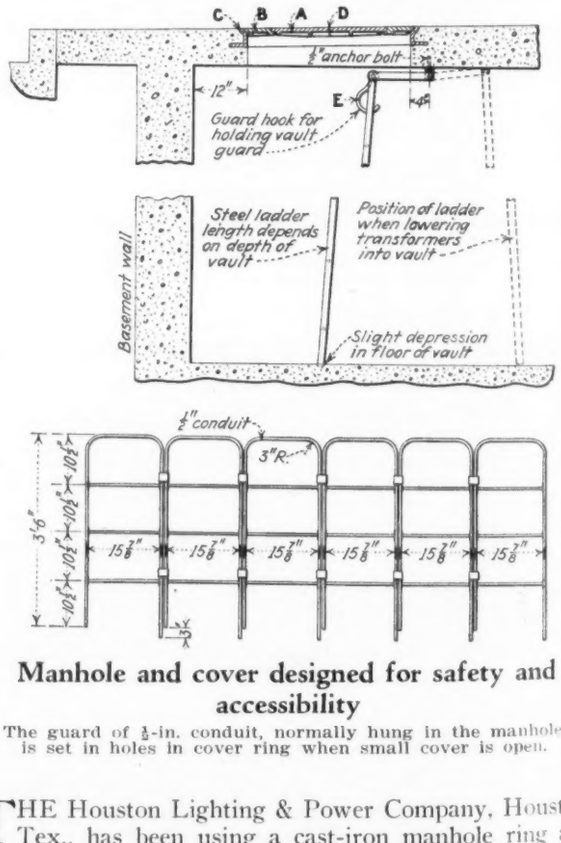
Cast-Steel Covers for Network Vaults

By E. F. SEAMAN

Engineering Department, Houston Lighting & Power Company, Houston, Tex.



Manhole and cover designed for safety and accessibility

The guard of ½-in. conduit, normally hung in the manhole, is set in holes in cover ring when small cover is open.

THE Houston Lighting & Power Company, Houston, Tex., has been using a cast-iron manhole ring and cover which weigh, respectively, about 646 lb. and 450 lb. This is suitable for heavy traffic streets. With the advent of the secondary network and sidewalk manhole installations it has been thought advisable to use a lighter and more convenient cover. For this purpose a light, cast-steel, double-cover manhole has been designed for

sidewalk use. It consists of an inner cover 24 in. in diameter, *A*, and an outer cover, *B*, 36 in. in diameter, which fit into the ring *C* as shown in the sketch. The surfaces are machined where they fit in their respective rings so as to insure an even surface and prevent chattering. The inner cover weighs 86 lb., the outer cover 181 lb. and the ring 183 lb., the total cost being about the same as that for the heaviest street type cover and ring. The lifting ring, *D*, dispenses with hooks for the small cover.

The entrance ladder is so designed that it can be conveniently used with either the small or larger opening. Its normal position is shown by the solid lines. For the larger opening the lower end is raised a short distance from the floor, swung to the right and placed in the position shown by the dashed lines. The guard rail hangs on the hook *E*. The inner ring is provided with a hexagonal set of holes into which the guard is placed, when the small cover is off, anchoring it rigidly so it cannot be knocked over. The closely spaced lateral pipes on the guard are intended to keep small children from walking under or easily crawling through the guard. With this layout it is possible for one man to make an inspection of a manhole and have it securely guarded.

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An Application of Switch Interlocks

By S. J. SPURGEON

Engineering Department, Alabama Power Company

THE Alabama Power Company believes it desirable to be able to remove single-phase induction regulators from service safely and without interrupting service on the particular current involved. This is accomplished by means of mechanically interlocked isolating and by-pass switches mounted in a steel cabinet, all of which are made foolproof by interlocking their operation with the regulator by means of interlocks.

One set of isolating and by-pass switches is provided for each regulator, so that any one regulator may be taken completely out of service without disturbing the other units. Each set of switching equipment consists of one disconnect switch for the by-pass, two disconnect switches for isolating the secondary and one primary lead, one disconnect switch to isolate the other primary lead and a small, inexpensive oil switch to break the charging current in the primary circuit. All these switches are mechanically interlocked so that the sequence of operation in taking a regulator out of service is:

1. By-pass switch short circuits secondary.
2. Oil switch opens, breaking the charging current.
3. Isolating switches open, which completely isolates regulators.

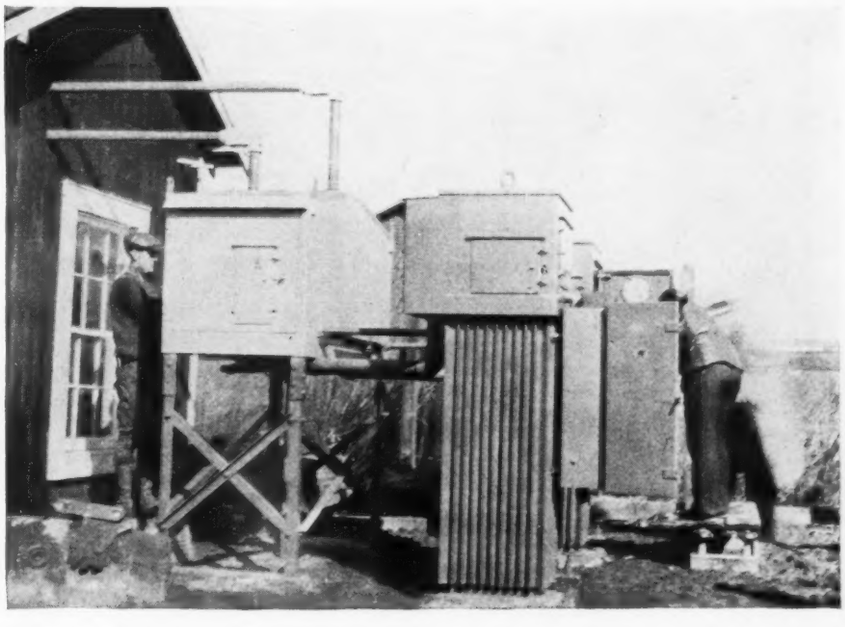
When placing the regulator back in service the opposite sequence of operation takes place.

In order to accomplish successfully and safely the switching it is necessary first to have the regulator in neutral position. To make the arrangement foolproof and be assured that the regulator is actually in neutral an interlock is installed so as to engage the rotor shaft in the neutral position. The key in the interlock cannot be removed until the neutral position is reached.

In removing the key the control circuit is disconnected so the motor cannot be operated either by hand control or by automatic control. This same key then is used to open a small door in the switch cabinet. An operating handle is inserted through this door and with one upward motion the regulator is completely isolated. It is impossible to remove the operating handle until all the switches are completely opened or closed.

A large door which gives access to all the switches is also provided so that all switches can be visually checked for clearance. This large door is interlocked with the small door so that until the small door is opened the large door cannot be opened. This protects an operator from harm in case of failure in the cabinet when the switches are operated.

The interlock key in each regulator unlocks only the compartment controlling a particular regulator, hence it is impossible for an operator to open the wrong switches. These cabinets are completely wired by the manufacturer and ready to be connected to the circuit as soon as placed on the foundation. All units are provided with outlets so that either conduit or open wiring can be used to connect to the circuit.



A conduit installation outside a switch house

The installation for open wiring is provided with roof type bushings and all that is necessary to install this type of equipment is to interpose strain insulators in the line and connect the incoming and outgoing leads to the line. This type of installation reduces field labor to a minimum and adds little, if any, to material costs, and above all it insures safety of operation.

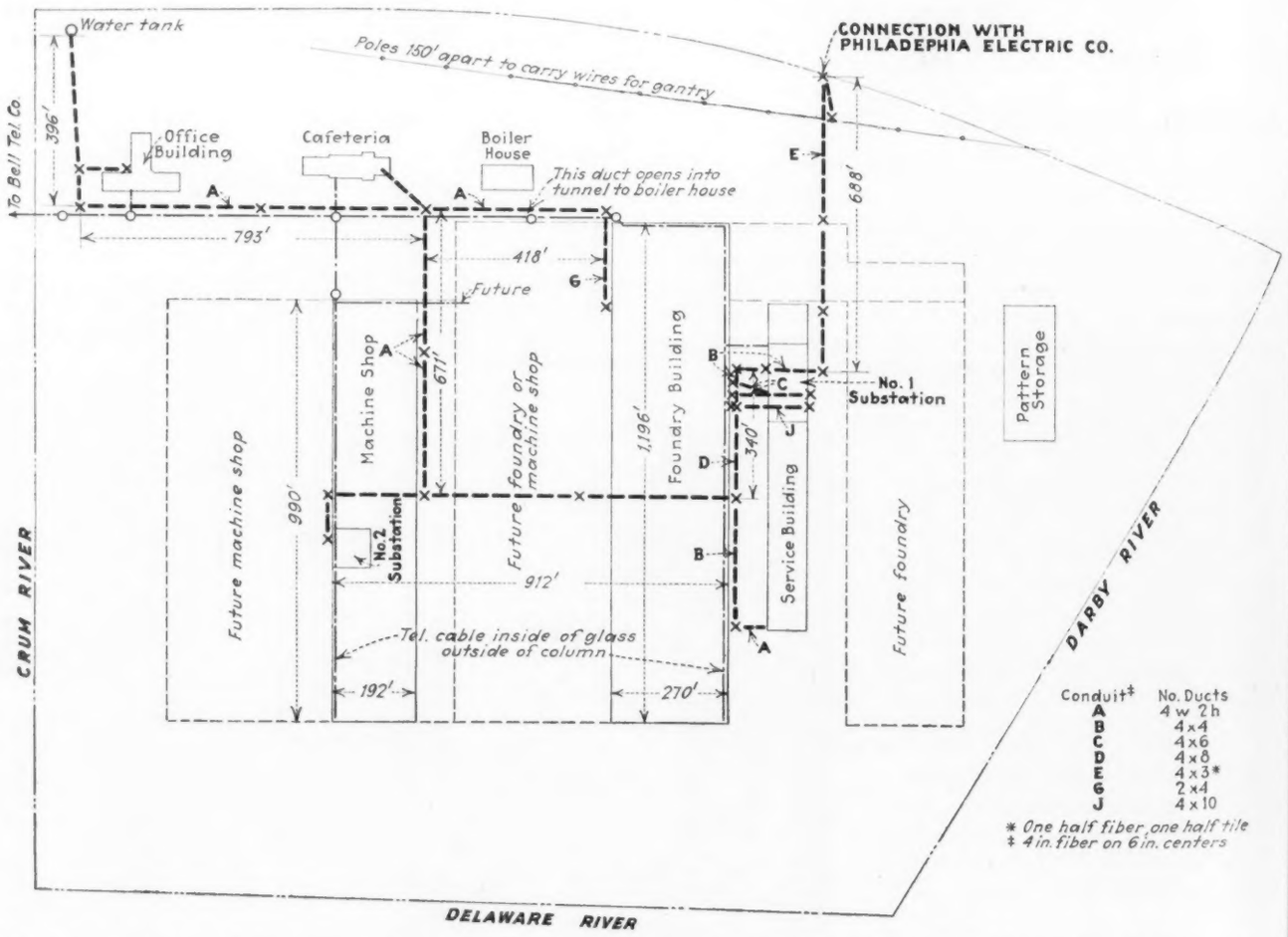
Believes in Spending Money

for Continuity of Servic a

MANY industrial plants are apparently laid out as though the electric service facilities are just a necessary evil and a non-productive investment. In many cases too little thought is given to providing spare units, space for future equipment, emergency switching or any additional facilities that help to avoid service outages and allow for future growth.

But the $13,000,000 Eddystone (Pa.) plant of the General Steel Castings Company, which is just starting operation near Philadelphia, is a striking exception. When the plant design was first started, reliable electric service was recognized as an essential tool in accomplishing those economies so essential in these days of intense competition. The electrical engineering department was apprised of the plant production and operating problems and no expense was spared to provide for present needs or even the future. It is difficult to imagine how the plant, even if it grows, will ever be handicapped for electric service facilities.

While reserve equipment was installed in many places and space was provided for adding future equipment, money was not thrown away on facilities which are not needed now. It is true that some spare capacity has been provided that some industrial plants might not consider necessary. But when it is realized that interruptions in electric service in any part of this plant would



Underground conduits connecting power supply, substations and buildings avoid overhead obstructions

Conduits having four to 40 ducts and manholes about every 350 ft. are laid in damp soil, facilitating radiation. Manholes at each building wall permit connecting underground feeders with open-wire feeders inside buildings along elevation of roof girders.

and to Facilitate Expansion

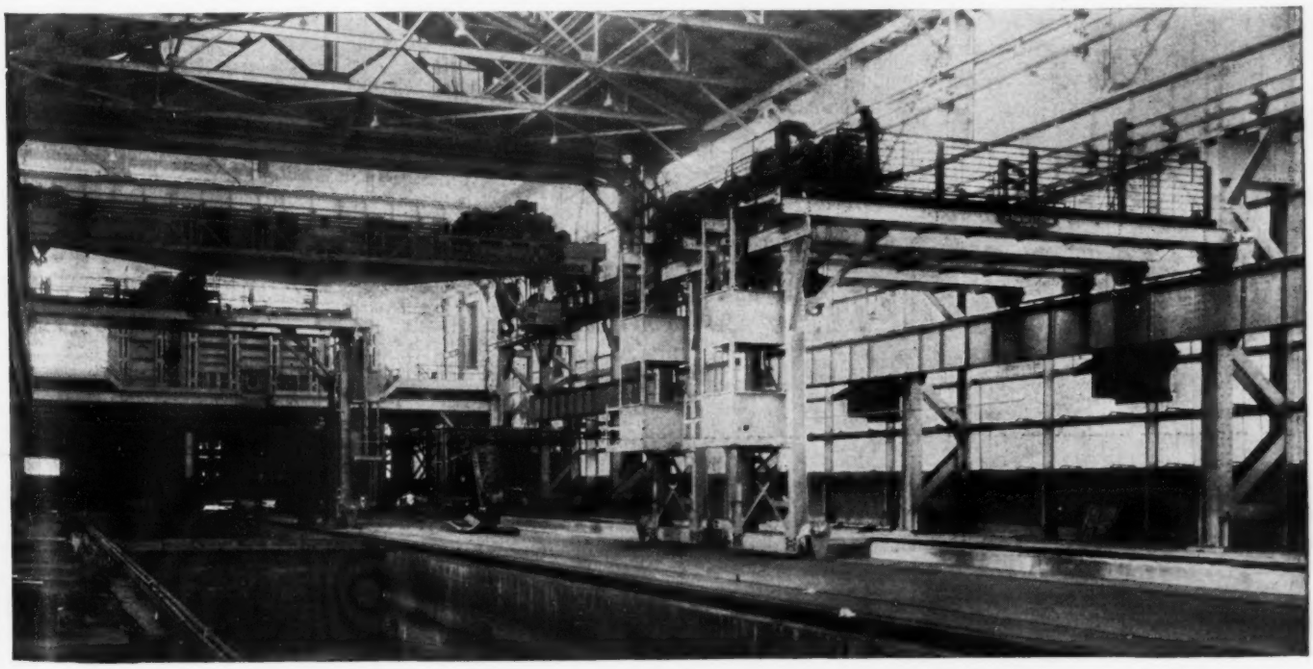
reduce the utilization of $13,000,000 in productive equipment, building and land, to say nothing of the hourly outlay for labor, the flexible service facilities seem like a very reasonable insurance for maximum usefulness of total investment. This is more evident when it is recognized that fixed and operating charges (exclusive of materials and power) pile up at the rate of $550 an hour, so just one idle period of this length will justify an expenditure up to seventeen times this value for facilities over and above those for service to prevent outages.

To comprehend the requirements which influenced the electrical design, it is advisable to review briefly the functions of this plant and the nature of the operations. The Eddystone plant is designed to produce 60,000 tons of steel castings a year in units ranging from 20 lb. to 150,000 lb. apiece—the largest yet made. To produce these castings at a price which will compete with other castings and welded structures mass production methods involving a progressive flow of materials have been applied to even the largest castings, by breaking down the manufacturing processes into component operations.

WHAT value is modern productive equipment if the transformers, circuit breakers, circuits, motors or control apparatus which serve the productive machines become inoperative? How can plant investment and labor expense be utilized to the maximum extent if lighting is inadequate for efficient work? How can continuity of operation, so essential to minimum cost, be expected if the life blood and nerves of the system are slighted? What provisions have been made for emergency operation and expansion or changes?

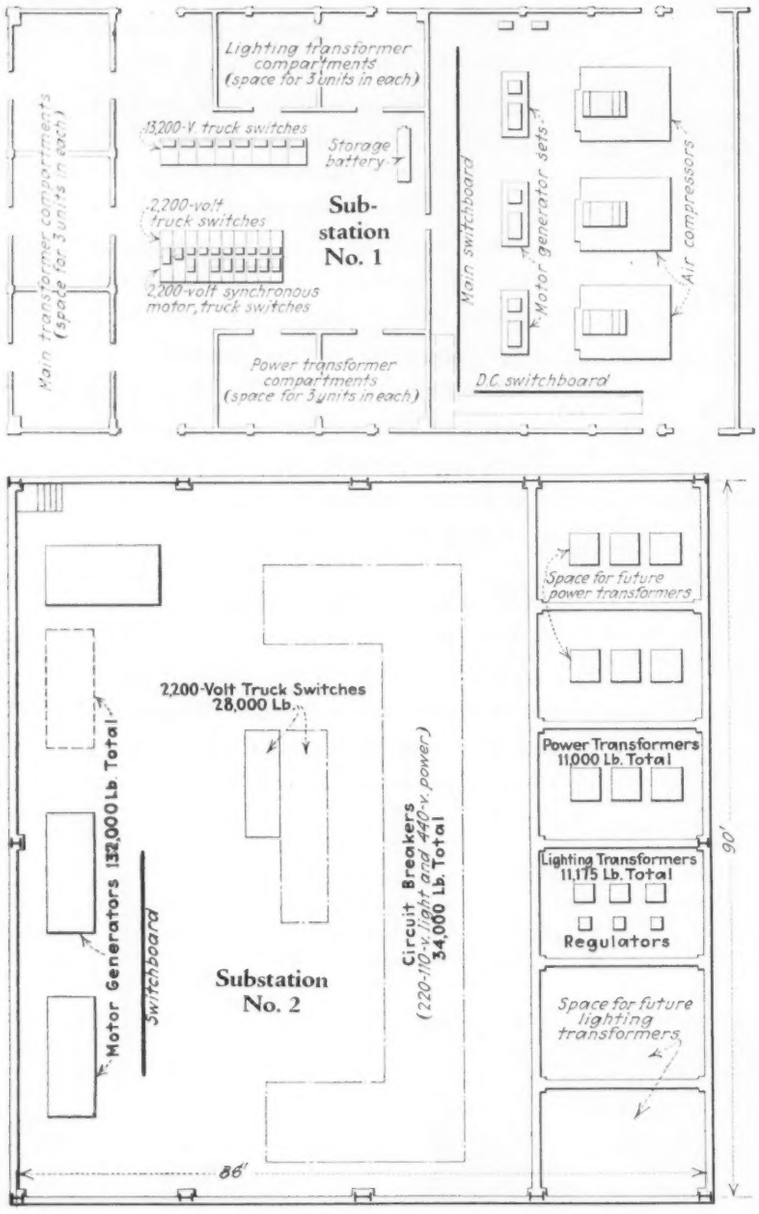
THE General Steel Castings Company is one industrial concern which recognizes that reliable electric service facilities and equipment are essential to economical operation and not merely an unproductive investment.

The entire plant has been built around master-flow charts that have been worked out after critical review of various production methods. The general layout is shown in an accompanying illustration.



Three varieties of electric cranes extensively used in foundry

Two 90-ft. cranes may be seen in the background. In the foreground are two other types that span only the pouring pits and are used for different loads. This shows only one of the three bays in the foundry, each equipped with material-handling facilities. Note contact rails along columns. Twenty-eight cranes are used in the entire foundry.


Lighting transformer compartments (space for 3 units in each)
13,200-V. truck switches
Storage battery
2,200-volt truck switches
Sub-station No. 1
2,200-volt synchronous motor, truck switches
Main transformer compartments (space for 3 units in each)
Power transformer compartments (space for 3 units in each)
Main switchboard
Motor generator sets
Air compressors
D.C. switchboard
Space for future power transformers
2,200-Volt Truck Switches 28,000 Lb.
Power Transformers 11,000 Lb. Total
Lighting Transformers 11,175 Lb. Total
Regulators
Motor Generators 132,000 Lb. Total
Switchboard
Substation No. 2
Circuit Breakers (220-110-v. light and 440-v. power) 34,000 Lb. Total
Space for future lighting transformers
86'
90'

Substation layouts allow for growth

Space is allowed for future transformers, motor-generators, compressors, switchboards and breakers. Substation No. 2 is located in roof trusses of machine shop and is designed for 137 tons of major equipment. Power and lighting feeder breakers in substation No. 1 are located on balcony above respective transformer banks.

Some of the major uses of power are best visualized by hastily tracing raw materials through the plant to the delivery of the finished product. Throughout it will be observed that electrically operated and controlled material-handling equipment is used to an extensive degree. For example, raw materials are transferred from cars in the classification yard to and from storage by a mammoth gantry crane operating over a 2,000-ft. track. Furnace charges are conveyed from storage by cars electrically pulled up an inclined track to the charging floor, where the charges are inserted in the 50-ton open-hearth furnaces, at one end of the foundry room, by electrically operated and controlled chargers. From these elevated furnaces molten metal is poured into ladles that may be conveyed the entire length of the 1,200-ft. foundry by electric cranes.

The foundry room is divided into three longitudinal bays; the central one is used chiefly for preparation of cores, the outer ones for pouring molds. Along the column lines between bays are sand conveyors and sand mixing, distributing and stacking machines and core-baking ovens. This layout permits a progressive flow of material and parts through the plant. The core patterns are brought into the central bay at the end remote from the furnaces and gradually moved toward the furnace end as preparation of the cores progresses. Sand for making the molds and cores is available wherever needed in the three bays. The completed cores are introduced into the pouring bays exactly where needed. In these bays the work moves away from the furnaces to the delivery end of the foundry.

It is in the foundry room where cranes are most conspicuous in number and variety, there being 28 cranes ranging from 2-ton gantry cranes that span less than half a bay to 75-ton girder cranes spanning 90-ft. bays. If a load does not justify the use of a heavy slow-moving crane, one just adapted to the load can be used with greater speed. An accompanying cross-section shows how these cranes are arranged so they may pass each other with a load. These cranes also permit the collective transfer of cores or castings, eight 10-ton boats being provided which will convey 40 to 50 cores from the pattern storage to central points of distribution in the foundry. Smaller cranes may be used to distribute the cores to the exact spot of utilization.

Another unusual feature of this foundry is the use of various depth pits in the pouring bays which allow a uniform working level regardless of the height of the molds or castings. As may be observed from the plant layout, the present foundry is some 450 ft. from the machine shop, but this space and the other vacant ground space indicated are provided to permit erection of future foundry and machining buildings. The ends of the existing and future buildings are connected by a transfer track on which castings from the foundry are brought through the sandblast and annealing furnaces to the machining building. One interesting feature of the machine shop, that simplifies the electrical distribution, is the diagonal arrangement of the larger machines along the center line of the building, where they will be convenient to elevated open-wire circuits running along the column line. This arrangement is shown on page 1085.

Unlike the foundry room, where the most conspicuous use of power is for crane operation, the machine shop employs electrical equipment chiefly for driving and controlling the machine tools.

Throughout the foundry and machine shop artificial as well as natural lighting has been considered a pro-

ductive investment and operating expense. There are no twilight zones. Aluminum reflectors set on 25-ft. centers 46 to 48 ft. above the floor and containing 500- or 750-watt units flood the buildings with light not often found in such plants. Of course, this general illumination is supplemented with local lighting at the machines to aid setting up of work, adjustment of tools and observation of operations.

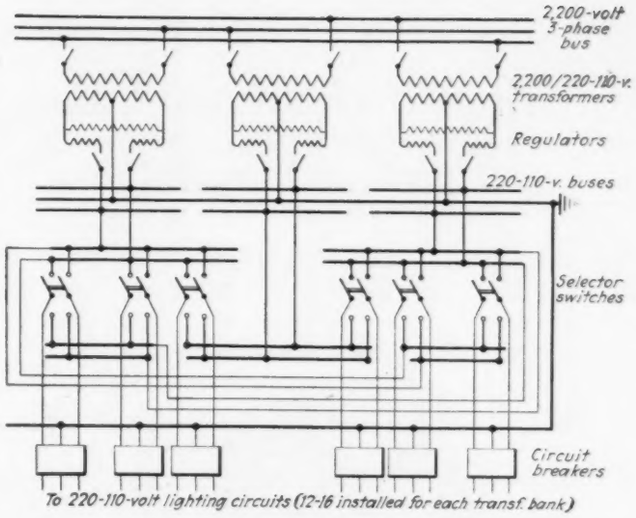
Distribution system designed for growth

Some engineers who calculate exactly what power is required by each motor and section of a plant, to determine load centers, and wire or switch sizes, may be shocked to hear that this plant was not laid out this way. Past experience of the General Steel Castings Company indicated that certain amounts of power are required for different operations, but if only these requirements are provided they are quickly outrun. Consequently the average requirements for different operations were multiplied by two or three, so far as providing distribution facilities and allowing space for future equipment were concerned. Furthermore, by laying out the plant according to a logical scheme of production that would take care of the future, it was not essential to provide for shifting of machinery, although the distribution system is arranged so loads may be cared for wherever they develop.

As may be observed from the general plan of the General Steel Castings Corporation site, the present loads are concentrated chiefly in the foundry and secondarily in the machine shop, the connected loads in these two buildings being as follows:

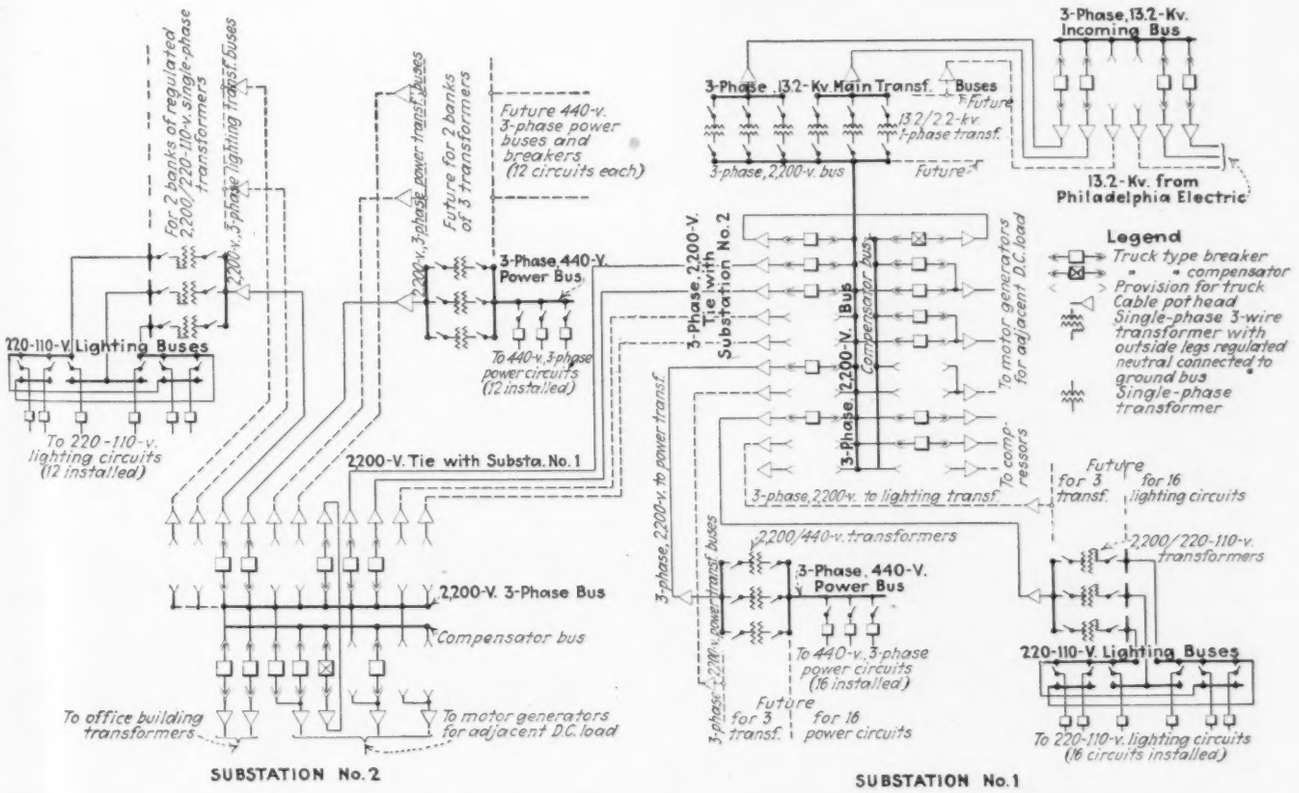
Character of Load	Connected Horsepower* Foundry	Machine Shop
250 volt d.c.	3,968	1,750
440 volt a.c.	1,380	270
220/110 volt a.c.	260 kw.	200 kw.

* Includes cranes.



Little opportunity exists for failure of lights

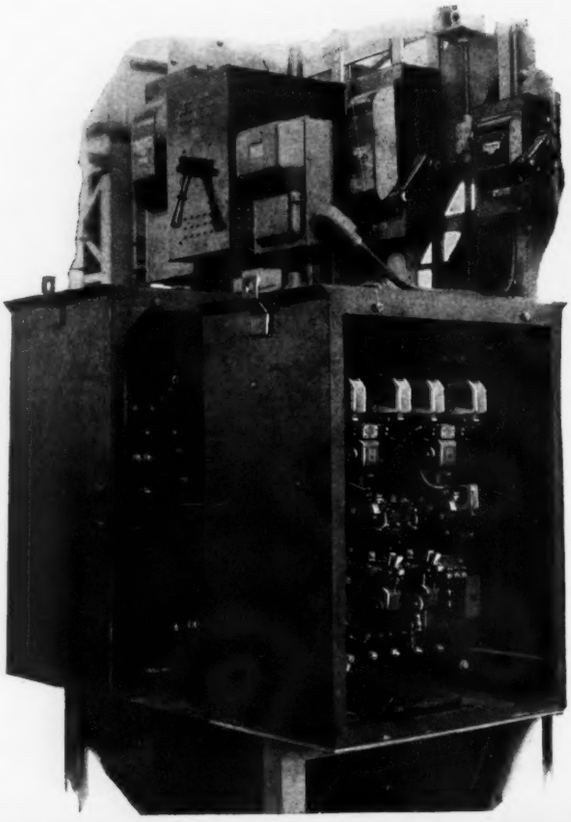
With these sectionalized buses and throw-over switching arrangements reliable lighting service seems assured in the foundry and machine shop.

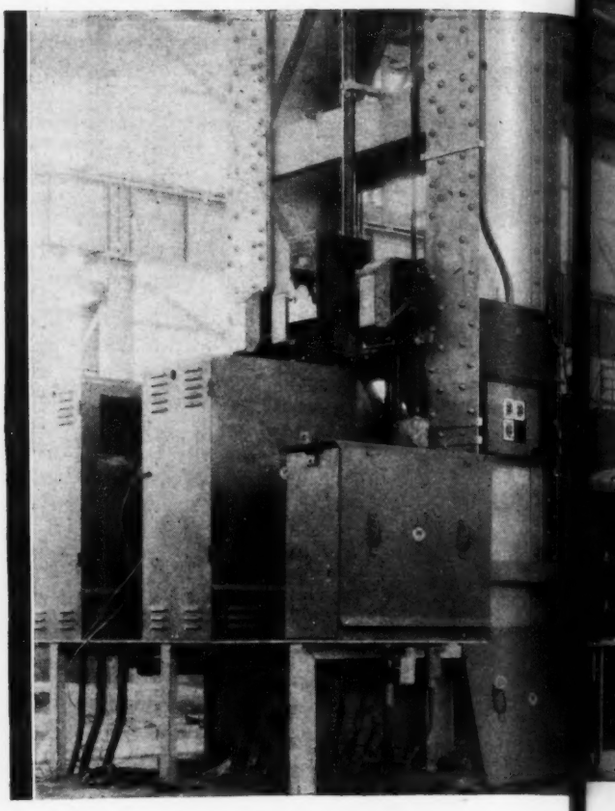

For 2 banks of regulated 2,200/220-110-v. single-phase transformers
2,200-v. 3-phase lighting transf. buses
220-110-V. Lighting Buses
To 220-110-v. lighting circuits (12 installed)
2,200-v. 3-phase power transf. buses
Future for 2 banks of 3 transformers
Future 440-v. 3-phase power buses and breakers (12 circuits each)
3-Phase, 440-V. Power Bus
To 440-v. 3-phase power circuits (12 installed)
2200-V. Tie with Substa. No. 1
2,200-V. 3-Phase Bus
Compensator bus
To office building transformers
To motor generators for adjacent D.C. load
SUBSTATION No. 2
3-Phase, 13.2-Kv. Incoming Bus
3-Phase, 13.2-Kv. Main Transf. Buses
Future
13.2/2.2-kv. 3-phase transf.
3-phase, 2,200-v. bus
Future
13.2-Kv. from Philadelphia Electric
Legend
Truck type breaker
compensator
Provision for truck
Cable pothead
Single-phase 3-wire transformer with outside legs regulated neutral connected to ground bus
Single-phase transformer
3-Phase, 2,200-V. Tie with Substation No. 2
3-Phase, 2,200-V. Bus
Compensator bus
To motor generators for adjacent D.C. load
To compressors
3-phase, 2200-v. to power transf.
3-phase, 2200-v. to lighting transf.
Future for 3 transf.
for 16 lighting circuits
2,200/440-v. transformers
2,200/220-110-v. transformers
3-Phase, 440-V. Power Bus
To 440-v., 3-phase power circuits (16 installed)
3-phase, 2200-v. power transf. buses
Future for 3 transf.
for 16 power circuits
220-110-V. Lighting Buses
To 220-110-v. lighting circuits (16 circuits installed)
SUBSTATION No. 1

Flexibility of service and growth permitted by these switching facilities

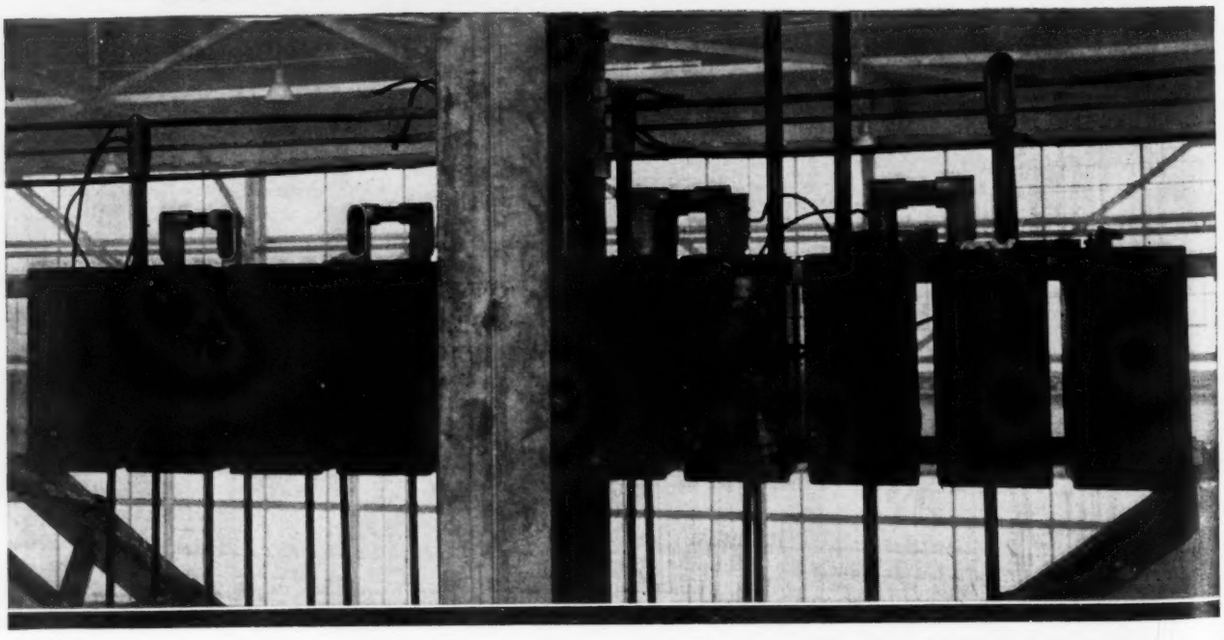
Note particularly provisions in substation No. 1 for triplicate power supply, triplicate main transformer banks, duplicate power and lighting transformer banks, 48 power and lighting feeders, and truck-type breakers. Also allowance in substation No. 2 for triplicate power and lighting transformer banks, truck breakers and 36 power and lighting feeders. Provision is made for four 2,200-volt substation ties. Substation No. 2 may be controlled locally or from substation No. 1.

Branch circuit controls grouped around columns





Position of branch-circuit controls utilizes otherwise useless space, permits short connections with overhead feeders and branch circuits above or below. Grouping of individual machine tool controls around columns places them near machines and so they can be fed from circuits above.



Machines served from open-wire circuits between girders

Branch circuit panels and control for power and light near tops of columns accessible to walkway but remotely controlled. Machine-tool control equipment grouped around bottom of columns. Note push-button pendant controls over machines.

While motor-generators for serving the 250-volt d.c. loads and transformers for 440- and 220-110-volt service could have been distributed through these buildings close to their load centers and fed with 2,200-volt feeders to cut down the distribution losses, the engineering department did not favor such an arrangement for several reasons. First of all, the electrical equipment and associated breakers, control, etc., for the foundry and machine shop alone would have been spread over more than 500,000 sq.ft. of floor surface. Besides, these two buildings are separated by 450 ft. Such a layout would have imposed at least two severe handicaps: (1) Protecting equipment from dust and workmen; (2) making it readily accessible for inspection, maintenance, repair, etc. This situation would be aggravated if the scheme were extended to the ultimate plant, which may occupy a ground space of more than 2,000,000 sq.ft.

As an alternative to this widespread layout of motor-generators, transformers, circuit breakers, etc., the equipment could have been concentrated in one main substation situated between the foundry and machine shop, so far as the present buildings are concerned. But even such an arrangement had its objectionable features. It would have hampered addition of standard buildings in space provided for logical expansion. It would have entailed considerable distribution losses in the ultimate plant. It would have concentrated too many eggs in one basket.

Considering the present load as well as the future, it was decided best to concentrate the motor-generators, transformers and feeder breakers in two substations, the major one (No. 1) near the end of the service building adjacent to the foundry, the other (No. 2) in the roof trusses near the center of the machine shop. These centers of distribution are relatively close to present load centers and will also be central to the foundries and machine shops that may be erected some day on each side of the existing buildings. Major equipment in substation No. 2 may be controlled remotely from substation No. 1 or locally. Centralized control is used to reduce attendance and minimize power outages.

Why purchased power was favored

With these centers of distribution selected consideration was given to providing a reliable and flexible power supply and feeder facilities between buildings. Continuity of service and ease of augmenting facilities were the dominating factors. Although it was decided to operate powdered-fuel-fired boilers to supply process steam, private generation of electric power was not chosen for the followng reasons:

With a private plant sufficient generating equipment would have to be installed to meet peak-load demands and still have reserve capacity in case of failure of one unit.

Provision would have to be made for expansion.

Since power plant equipment becomes obsolete with improvements of design, the company would be faced with substituting new equipment periodically to keep its unit costs of power comparable with purchased power.

A single generating station could not assure the reliability of service that a large interconnected system provides.

Money would be tied up in the power plant investment during business depressions, strikes, etc.

Additional demands for power could be more promptly served by purchasing power.

A generating plant would occupy space needed for future productive buildings and require additional engineering supervision to keep up with economies of utilities.

With purchased power the company can confine its attention to its business of producing and marketing castings.

These reasons, coupled with the rate obtained for purchased power, eliminated private generation from the picture.

Underground circuits between buildings

To take care of the present load, duplicate 13,200-volt feeds from the Philadelphia Electric Company's system were brought into substation No. 1 through underground conduit having ducts for additional circuits. These feeds will provide ample capacity and reserve for the ultimate plant.

As the General Steel Castings Corporation did not want to have overhead lines obstruct future erection of buildings, tie-lines between these substations and circuits from them to the various buildings were carried through underground conduits. Their routes are indicated on the general plan. Underground feed between buildings also removes important circuits from the hazard of mechanical breakage or short circuit and still permits relatively easy installation of additional circuits. Some 90,000 lin.ft. of underground duct line and 28 manholes are installed for power circuits, the conduits ranging from 4-duct to 40-duct cross-sections, with manholes about every 350 ft. The maximum separation between manholes is 419 ft. The ducts are laid in ground which is perpetually damp due to the proximity of the river, so radiation of heat is excellent. Every circuit is identified by a tag, each circuit carrying the same number throughout.

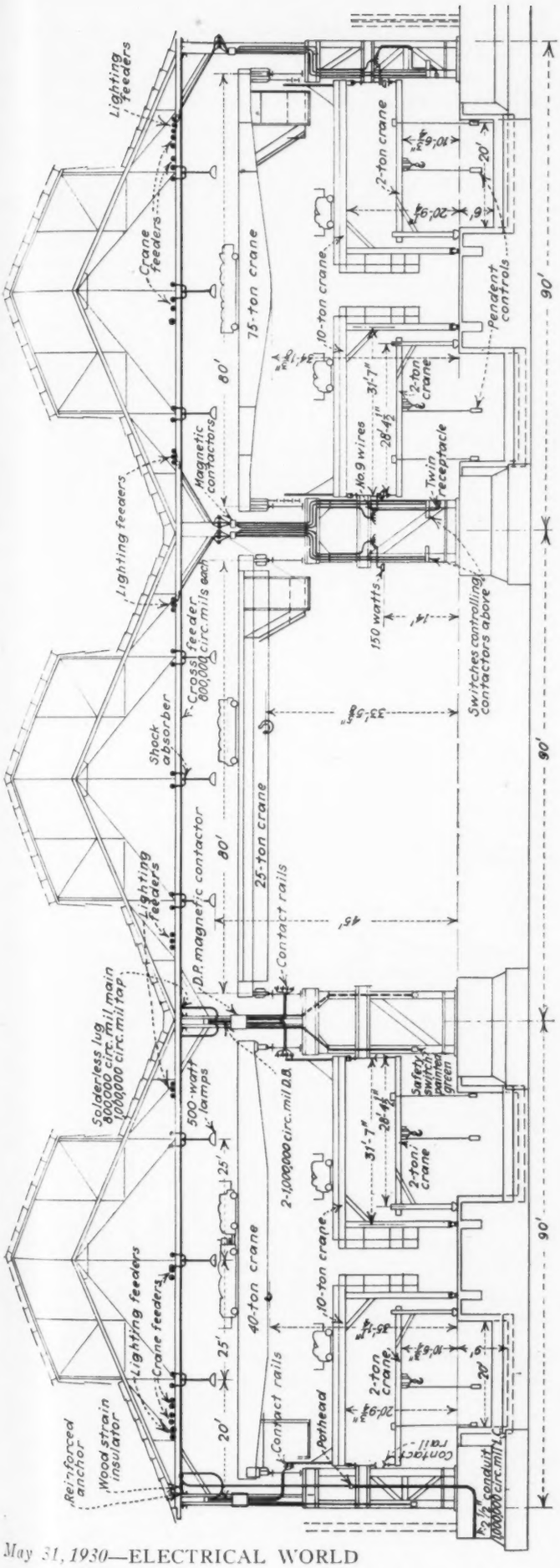
Two substations at load centers

The layout and connections of electrical equipment in substations Nos. 1 and 2 are shown in the accompanying illustrations. It may be observed that space is provided in substation No. 1 for three banks of 13,200/2,200-volt transformers, two banks of 2,200/220-110-volt lighting transformers, two banks of 2,200/440-volt power transformers, eight 13,000-volt truck switches, twenty 2,200-volt truck switches, a main switchboard adequate for the ultimate development, three motor-generators and three air compressors. The buses and feeder breakers for the 440-volt and 220-110-volt circuits are installed on balconies over their respective transformer banks, space being provided for 36 circuits on each balcony.

Substation No. 2, which is in the roof trusses of the shop, measures 86x90 ft. and contains major equipment weighing about 137 tons. Here space is allowed for three banks of power and lighting transformers, twenty-two 2,200-volt truck switches and 72 power and lighting breakers. As pointed out previously, the equipment in this substation may be controlled locally or remotely from substation No. 1 over control wires.

Automatic reclosing breakers set for a predetermined interval before reclosure, now ten seconds, are used on the d.c. switchboards. To offset the lagging power factor of the induction motor load throughout the plants and to keep the power factor above 95 per cent synchronous motors operated at leading power factor are used to drive the motor-generator sets and air compressors.

Incoming power is metered twice, by the Philadelphia



How distribution inside foundry is provided for cranes and lamps

In general, conduit risers from underground feeder system run up just inside an outside wall of each building and connect at the roof-girder level with open-wire cross-feeders tapped to longitudinal feeders, which in turn run to branch-circuit equipment on columns near roof. The lighting equipment is remotely controlled from floor level by toggle switches.

Electric Company and by the General Steel Castings Company. At present two banks of power transformers are installed for incoming power, either of which has sufficient capacity to serve the plant, leaving one bank as a spare. To give better regulation of the lighting circuits under unbalanced conditions, induction regulators are connected in the low-voltage sides of the lighting transformers.

Flexible switching and spares capacity

A study of the diagram showing electrical connections in these substations will convey a clearer picture of the design than any amount of words if circuits are traced from the Philadelphia Electric supply through to the applications. Attention might be called to some characteristics, however.

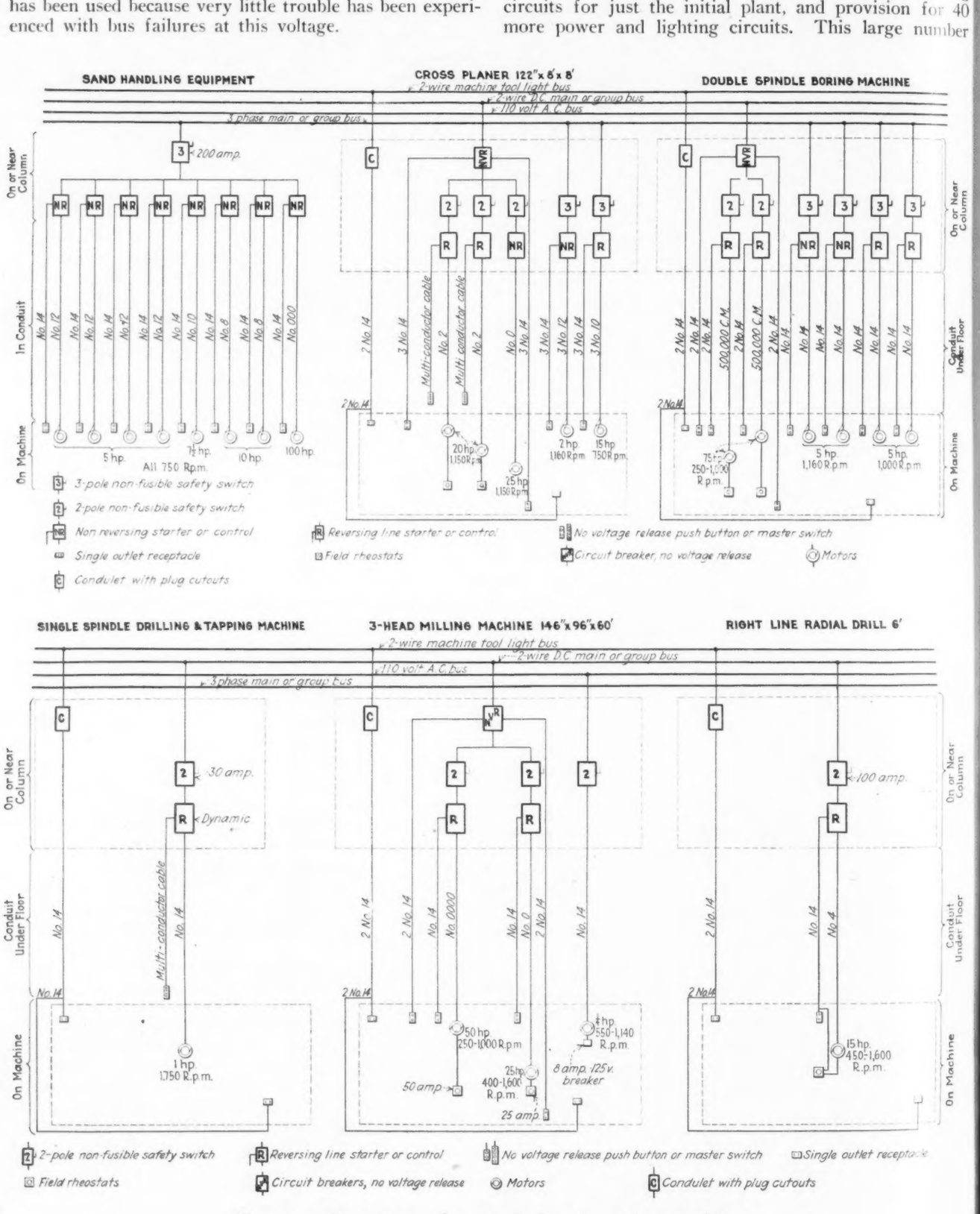
Throughout it will be observed that spare equipment and spare circuits, as well as provisions for the future, are quite prominent. In substation No. 1 there are arrangements for triplicate power supply, triplicate banks for main transformers, duplicate power and lighting transformer banks, flexible switching for lighting and triplicate compressors and motor-generators. Between substations Nos. 1 and 2 are provisions for four 2,200-volt and four 250-volt d.c. tie circuits. In substation No. 2 are arrangements for triplicate lighting and power transformer banks, triplicate motor-generators and flexible switching for lighting. The use of truck switches affords the advantage of quick replacement in case of failure, or when necessary for inspection and maintenance.

In a few places, however, buses are not duplicated or sectionalized. For example, the 13,200-volt truck bus, the 2,200-volt bus for the main transformers and truck switches and the 440-volt power bus are not sectionalized, nor is provision made for throwing the circuits on the duplicate buses.

There is a reason for these apparent inconsistencies. For example, the duplicate or triplicate equipment is provided for at least two reasons: (1) To allow growth by addition of units; (2) to permit service if one of the pieces of equipment becomes inoperative. Furthermore, it should be observed that the equipment which is duplicated includes that which experience has shown is the most liable to fail. Truck buses have not been duplicated because very little trouble has been experienced with 2,200- and 13,200-volt buses so inclosed. The 2,200-volt bus for the main transformers has not been duplicated or sectionalized because it is installed outside the transformer fire walls. For the same reason the 440-volt buses have not been sectionalized, although they can be

easily. In both cases the transformers can be converted from delta to open-delta operation by bus disconnects outside the fire wall. No duplication of the 440-volt bus has been used because very little trouble has been experienced with bus failures at this voltage.

In addition to the direct-current feeders from motor-generator buses (chiefly used for cranes) are 28 440-volt, three-phase power feeders and 27 220-110-volt lighting circuits for just the initial plant, and provision for 40 more power and lighting circuits. This large number



Nature and position of controls for six major machines

Note that the control apparatus is mounted on or near building columns and fed by circuits coming down columns from elevated open-wire circuits running longitudinally through machine shop. Control buttons are located at convenient points around machines to avoid delays and for safety reasons in case of accident.

of circuits has been installed partly to avoid excessively bulky feeders, but chiefly so that any section in either the foundry or machine shop can operate independently of the others, so power use and consequently cost can be metered by departments, and so interruptions of feeder service will affect the smallest number of applications.

Simple but effective distribution inside buildings

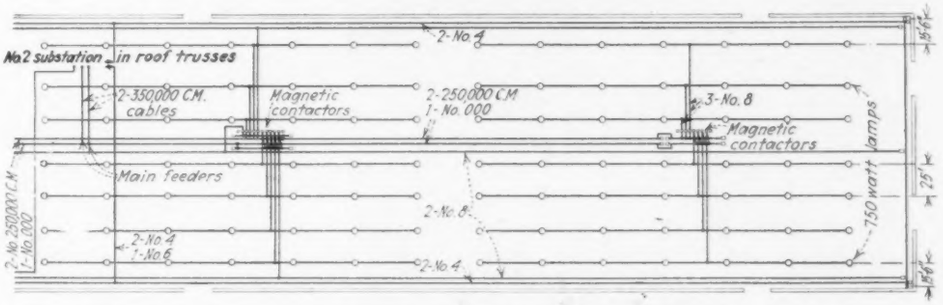
As previously mentioned, the main power supply, tie-lines between substations, feeders between substations and buildings are all run in underground ducts. At the building walls, where the underground feeders terminate, are manholes connected with conduit risers which run about 16 ft. up the inside wall. At this elevation are potheads from which open wires with slow-burning insulation continue to the elevation of the roof girders, where they are connected with similar open wires spanning the entire building. These cross-feeder wires are supported on each side of the building by anchors, wood strain insulators and clamps and by intermediate insulating supports. The cross-feeders, in turn, are connected with longitudinal feeders similarly supported and extending down each bay to their respective branch-service cabinets and inclosed magnetic contactors, usually mounted on or around the columns above the crane rails. The contactors are controlled by toggle or safety switches from the floor level, depending on the service. Connections with the crane rails and lighting circuits in the foundry are shown in an accompanying illustration. This arrangement of feeders and branch-circuit contactors is used for all distribution in the foundry and machine shop. It has several advantages: All circuits are readily accessible; faulty circuits can be readily tested; new circuits are easily added; taps can be made on feeders at any point; all branch circuit contactors are removed from working space, but are accessible from elevated walkways along column lines; feed to the crane rails or apparatus on the floor can be run down the columns; branch circuits to lamps are short and direct; feeders and control for each section of each bay, including the crane service, can be sectionalized.

In the machine shop, where the larger machines are set diagonally along the center-line of the building, this method of distribution is particularly convenient because branch circuits can be run along between the central columns over the machines, the branch circuits and contactors can be mounted near the upper parts of the columns and individual machine contactors and control equipment can be mounted on or near the lower portions of the columns. The circuits coming down the column as well as those from the control equipment to the machines are run through conduits. Only those portions of the conduits between columns and the machines are buried in the floor. The ease of running circuits and keeping the equipment out of valuable space, afforded by this arrangement, is more evident when the accompanying diagrams of controls for a few machines are studied.

Lighting distribution and control

Previously it was mentioned that excellent artificial lighting is afforded in the foundry and machine shop by aluminum reflectors equipped with 500- or 750-watt lamps. A cross-section of the foundry indicates how these reflectors are hung from the roof girders and fed by circuits running longitudinally down the bays supported by insulators on top of the girders. All of the fixtures are hung from condulet supported from vibration dampers. In the narrow bay of the machine shop are three rows of lamps and in the wider bay are four rows. An accompanying illustration, showing just two sections of the machine shop, indicates how these circuits are controlled from contactors mounted on platforms near the roof of the machine shop along the center-line of the building. As previously mentioned, these contactors are controlled from the floor level by toggle switches. There are seven lamps per circuit. As may be observed from the distribution layout, the controls for each section of the plant are concentrated at one point so that any row of seven lamps may be controlled separately.

Feeders to branch-circuit contactors come from substation No. 2 in roof trusses. The contactors are mounted on elevated runways along center line of building and are controlled by safety switches at floor level. Note sectionalized tie between contactor groups and feeders along center and sides of buildings for equipment below.



Flexible distribution system for two sections of machine shop lighting

Some major equipment

Transformers — Six 1,000-kva., 13,200/2,300-volt; three 333-kva. and three 200-kva., 2,200/440-volt; six 150-kva., 2,200/220-110-volt; all General Electric.

Motor-Generators — Two 750-kw. and one 500-kw. Elliot sets.

Air Compressors — Two 3,500-cu.ft. (Worthington) driven by synchronous motors (Westinghouse).

Storage Battery — One 125-volt (Edison) for oil switch operation with automatic charging apparatus (Westinghouse).

Motors — Large d.c. units for machine tools (Westinghouse); crane control (Electric Controller & Manufacturing Company) with Clark control; a.c. units (General Electric).

Among the men who contributed to the electrical design of this plant were W. R. Chambers, chief engineer, and E. Walcher, manager of operations of the General Steel Castings Corporation, and H. F. Transue, electrical engi-

neer of the Baldwin Locomotive Works, which with the American Locomotive Company, American Car & Foundry Company, the Pullman Company and American Steel Foundry Company jointly own the General Steel Castings Company.

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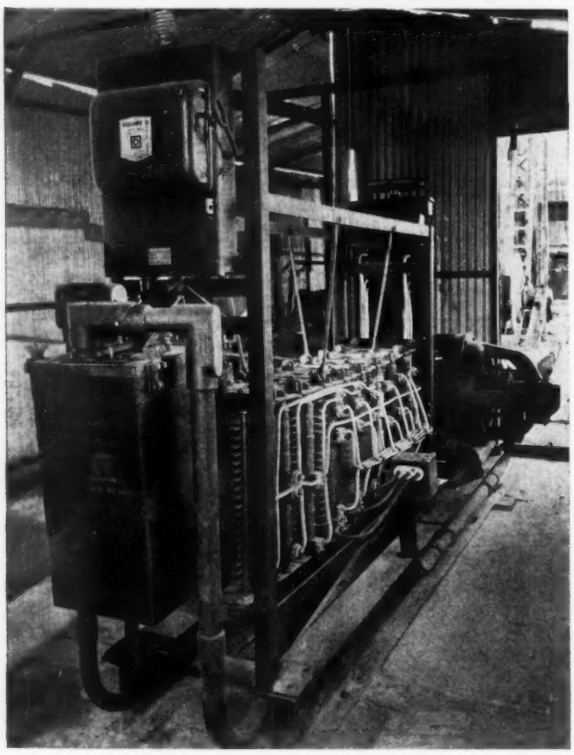
Unit Motor Assembly Permits Quick Pumping Set-up

AMONG certain industries, and particularly in the oil fields, a portable motor and control unit has the advantage of flexibility and low-cost shop assembly. The unit illustrated was developed by the Honolulu Oil Company for use on its leases near Taft and Bakersfield, Calif. It consists of an electrically welded frame, 26 in. in over-all width and 11 ft. long, made up of two 5x10-in. I-beams held together by short sections of 4-in. pipe welded at each end to the web of the I-beam. On this bedplate is mounted the double-rated pumping and pulling motor with drum controller, resistance grids and all wiring complete.



Shop-assembled motor and control unit can be moved to oil well and placed in operation in two hours

When a well is abandoned the salvage on the unit is 100 per cent

When a well comes in a unit can be set up and in operation in two hours, whereas formerly it required two to three days to set up an outfit on the job. The cost of these units is much lower than field-assembled installations by reason of less waste of material and the greater efficiency made possible by shop work. Moreover, in case of well abandonment the salvage value is 100 per cent.

The cost of the I-beam frame and the welding is $52.35 per unit and when completely assembled with a 15-30-hp. motor, control and wiring the cost is $1,386. Where six or more wells are to be pumped the cost per well, including distribution line, transformers, service and the unit pumping assembly described, can be kept within $2,000 per well.

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Rules for the Radio-Interference Detective

By H. A. MARTIN
Engineer Peoples Light & Power Corporation, New York City

MOST radio interference is caused by some sort of electric arc, in a loose connection, an arcing device, an X-ray tube, or originates from some other source of radio-frequency waves. The spark or arc may be very small and the resulting effect may be carried along the lines of the company for a considerable distance. Usually disturbances will be confined to the circuits in which they originate and in rare instances have been known to pass across from the secondary to the primaries of distribution transformers and cause the primary circuit to resonate and affect a considerable area. As a rule, any trouble on the primary circuit will be transmitted or induced into the secondary; frequently, however, disturbances will not pass from the primary to the secondary of a system through the transformer. Disturbances often travel for miles over a primary or a series street lighting system and affect all the sets throughout a large district. Any electric disturbance from arcs which will produce telephone interference will have a like, but more powerful, effect to the supersensitive radio receiver and lead to the discomfiture of the listener.

Two methods of location are in general use; one is with a battery receiving set and the other is to inspect the system without any special equipment. This latter method is more general than the former and in some cases gives very good results.

Test with customer's set

The inspection method of locating faults which cause radio receiving troubles should be begun at the source of the complaints. Then by inspecting and sectionalizing lines and disconnecting transformers and other equipment, including household devices, the trouble may be located. If the trouble is within the house affected, pulling the service switch may help to locate the trouble and then the transformer may be disconnected. The use of this method largely depends on the ingenuity of the investigator, but with the large number of alternating-current sets on the lines of the company it is becoming increasingly difficult to locate the troubles by sectionalizing.

With a direct-current battery radio receiver equipped with a loop aërial which may be used as a radio compass

the problem is simplified. This set then operates without energy from the company's lines and with the aid and in conjunction with the inspection method the faults may be located. This portable battery set should be set up near the suspected equipment and the volume of the set adjusted so that the sound of the disturbance is readily audible. Then the loop is turned so that the minimum amount of noise is heard and a reading of the volume and loop dials recorded. A line drawn perpendicular to the plane of the loop gives the direction of the fault, and several such readings plotted with approximate locations should locate the source of trouble. When the trouble is carried in a line the radio compass will indicate that the line is at fault, but the actual fault may be some distance away.

Transmission and distribution line construction should give consideration to these facts, so that in the future we would not be building sources of radio interference. It is evident from the above that these troubles may be transmitted to quite a remote distance from the source of trouble and thus might impose quite an expense on the company. It is also obvious from the above that construction should eliminate close proximity of pole-line hardware in order to prevent future troubles.

SOURCES OF RADIO INTERFERENCE AND THE REMEDY

Source of Trouble	Remarks
1. Transformers:	
1a. Cracked bushings	
1b. Incipient insulation faults, arc to case or between coils	1b. Remove transformer and install a new one.
1c. Poor ground lead contacts	1c. Repair.
1d. Neutral ground with poor contacts	1d. Repair.
1e. Neutral ground in dry earth	1e. Dampen with bucket of concentrated copper sulphate (blue vitriol) or common salt solution
1f. Poor lead connection	1f. Repair.
2. Switching Apparatus:	
2a. Pole-top switches—loose contacts	2a. Tighten or sweat firmly.
2b. Transformer cut-outs	2b. Tighten.
2c. Fuses—loose contacts	2c. Tighten.
2d. Splices and taps—loose contacts	2d. Sweat firmly.
3. Lightning Arresters:	
3a. Leaking arrester	3a. Ordinary split-core C.T. with ammeter will indicate flow of current in ground conductor of leaking arrester.
3b. Arcing contacts	3b. Join firmly.
3c. Arcing at horn-gaps	3c. No remedy; only temporary, and for this reason usually not objectionable.
3d. Electrolytic (aluminum cell) arresters—during charging	3d. The charging should be done in the early hours of the morning.
4. Series Street-Lighting Systems:	
4a. Arcs caused by film cut-outs	4a. No remedy unless the cut-out is faulty, in which case it should be removed.
4b. Arcs in broken porcelains	4b. Install new porcelain.
4c. Discharges to ground, through metal parts of line hardware, or through pole	4c. Rearrange to eliminate discharges.
4d. Discharge to ground through trees	4d. Eliminate contact with trees by cutting limb or using tree wire.
4e. Arcs in poor contacts	4e. Tighten contacts or sweat them.
4f. Disturbances emanating from compensator type units	4f. Remove and install unit without compensator.
4g. Arc lamps (magnetite or other kind)	4g. Remove and install incandescent lamps, either multiple or series system.
4h. Arcs supplies by mercury-arc rectifiers or bush arc machines	4h. Remove and install incandescent system, either multiple or series.
4i. General troubles from series lighting system	4i. If economical remove and install multiple system.
5. Household Devices:	
5a. Loose contacts at entrance switches, fuse plugs or lamp sockets	5a. Repair { Troubles originating in one house may be sent over the secondary and affect
5b. Series commutator motors on devices	5b. Repair { several houses in the area even though the troublesome arc is small.
5c. Thermostats with apparatus	5c. Unless out of order seldom cause much trouble.
5d. Violet ray machines	5d. Disconnect from lines.
6. Miscellaneous Apparatus:	
6a. X-ray machines	6a. Disconnect from system or isolate.
6b. Vibrating rectifiers	6b. Disconnect from system or isolate.
6c. Smoke and dust precipitators	6c. Disconnect from system or isolate.
7. Transmission and Distribution Lines:	
7a. Insulator leakage through core	7a. Disturbance will be carried a few spans.
7b. Insulator arc-over	7b. Disturbance will be carried over entire transmission system until dissipation.
7c. Arcing ground, contacts with trees or other manner of grounding	7c. If on distribution system tree-wire may be used, otherwise trim tree or remove other ground. This disturbance will be carried a considerable distance.
7d. Secondary grounds. Both those made as neutral grounds and accidental grounds will cause disturbance	7d. Secondary neutral grounds must have a low resistance to eliminate radio troubles. If resistance is high pour a bucket of copper sulphate solution in a hole dug around ground rod.
7e. Poor contacts in ground lead	7e. Solder all joints in ground lead.
8. Telephone and Telegraph Lines:	
8a. Inductive interference	8a. Any inductive interference that would affect telephone communication will in most cases be transmitted to radio receivers.
8b. Ringing machines, pole changer types	8b. If antenna is parallel to telephone service wires, connect it perpendicularly.
9. Motors, Generators, Converters and Rectifiers:	
9a. Sparking commutators	9a. Regrind and adjust brushes. These disturbances often are carried over lines on both the d.c. and a.c. side.
9b. Elevator motors, d.c.	9b. The opening and closing of the contactors is cause of disturbances. Noticeable usually in building of trouble source.
9c. Mercury-arc rectifiers	9c. Sometimes produce radio waves which may be spread by d.c. system. Generally indicates the early failure of the tube.

Suggestions for Avoiding Faulty Ground Relay Action

By ROY M. SMITH

Westinghouse Electric & Manufacturing Company

MANY companies have been experiencing almost 100 per cent correct operation of their phase relays, but have been unable to explain why their ground relays did not perform equally as well. Several methods for preventing incorrect operation of ground relays on double faults to ground are described in this article. At least one of them can be selected which should be helpful on those systems experiencing frequent service interruptions from faults of this nature.

DIRECTIONAL overcurrent ground relays, connected to measure the residual current and voltage, will operate improperly if two phases are simultaneously faulted to ground at different locations on the system. The improper operation can be prevented by locking out the ground relays for this type of fault and allowing the proper phase relays to clear the trouble. Such a scheme does not wholly eliminate the use of the ground relay but merely removes it from the circuit during times when it might operate improperly.

The majority of line failures originate as single-phase-to-ground faults and the proper application of ground relays will usually allow a fault to be cleared before the trouble can spread to the two other phases. For this reason most companies install ground relays, and if the system is at all complicated, directional relays are used and connected as shown in Fig. 1 to measure the residual, or zero phase sequence, current and voltage. This scheme of connections has many advantages. Among these are the facts that only one relay is required to protect each of the three phases, and it may be made very sensitive and set for values of current much below full load, since the residual current is normally zero.

Occasionally a short circuit originates as a double fault to ground or the arc is blown into one or both of the good phases before the proper ground relay can operate. In either case the ground relays should operate properly to clear the fault, providing the phase relays do not operate first, since the former receive only the zero phase sequence current. However, faulty operation will result in most cases where a double fault to ground occurs with one phase grounded at one location and the other phase grounded at some other location on the system.

On first thought, this type of fault would appear to be very uncommon and of such a remote possibility as to be unworthy of much consideration. Such is the case on many systems where the lines are single circuit, for there is small possibility of lightning striking simultaneously at two different locations on the system or of striking a second phase before the proper relays have had an opportunity to function. However, on grounded neutral systems having double circuit lines on the same pole construction there is a possibility of a phase arcing to ground and then involving a different phase in the adjacent circuit before the necessary relays can operate.

On a system grounded through a relatively high resistance the above condition applies, but another factor enters which greatly increases the number of single-phase faults developing into double faults to ground. This factor is the shifting of the system neutral, for when one phase becomes grounded nearly full delta voltage is applied between each of the two other phases and ground. A weak point in line insulation is thus overstressed and may fail, producing a double fault to ground, and the fault locations may be widely separated.

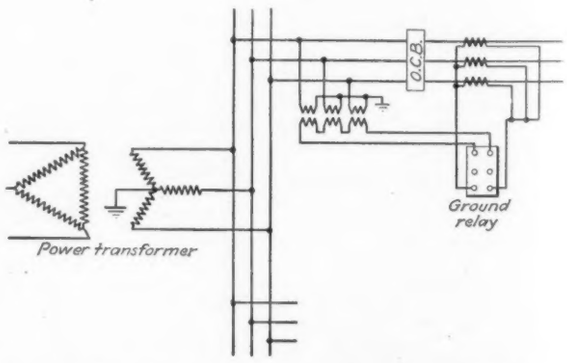


Fig. 1—Usual method of connecting directional overcurrent ground relays

The reason why this type of fault causes improper

operation of the ground relay directional element lies in the fact that the current received by the relay is not the true zero phase sequence current. It is the vector sum of the phase currents flowing in the lines to which the relay is connected. If the fault on one phase (say phase A) is close to the relay and on phase B is some distance away, the currents will not be equal (assuming, of course, that there is more than one path to the fault), but phase A current will be considerably larger than phase B current. Also the two currents will differ nearly 180 deg. in phase position. Therefore the residual current will be approximately in phase and equal to phase A current. However, with the fault conditions reversed—that is, phase B grounded close to the relay—the residual current will approximate phase B current. Since the residual voltage may be practically the same, the relay cannot properly indicate the direction of the fault for both of the two conditions.

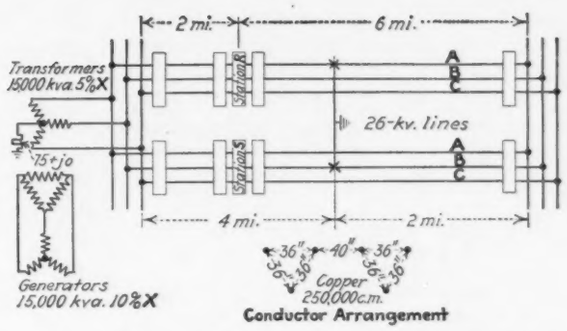
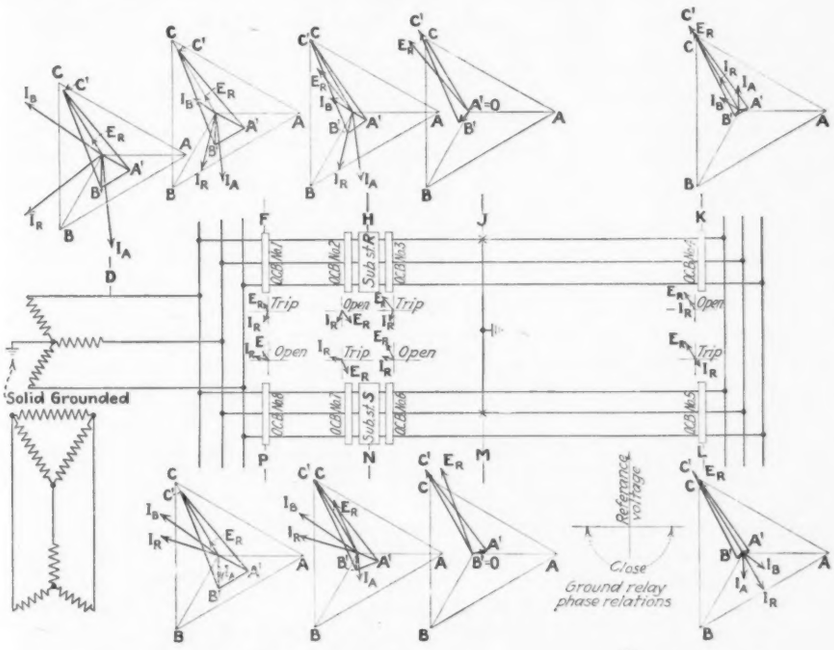


Fig. 2—Hypothetical system on which effect of double fault is based

Calculations have been made for a double fault to ground on the hypothetical power system shown in Fig. 2. Vector relations of the various voltages and currents in the solidly grounded system are shown in Fig. 3 and these values for a system grounded through a 75-ohm resistor

Figs. 3 and 4—Voltage and current relations for double fault to ground with system grounded solidly (left) and through 75-ohm resistor (below)

A = normal phase A voltage.
A' = phase A voltage for fault condition.
I_A = phase A current.
I_R = residual current = $I_A + I_B + I_C$
E_R = residual voltage = $E_{A'} + E_{B'} + E_{C'}$



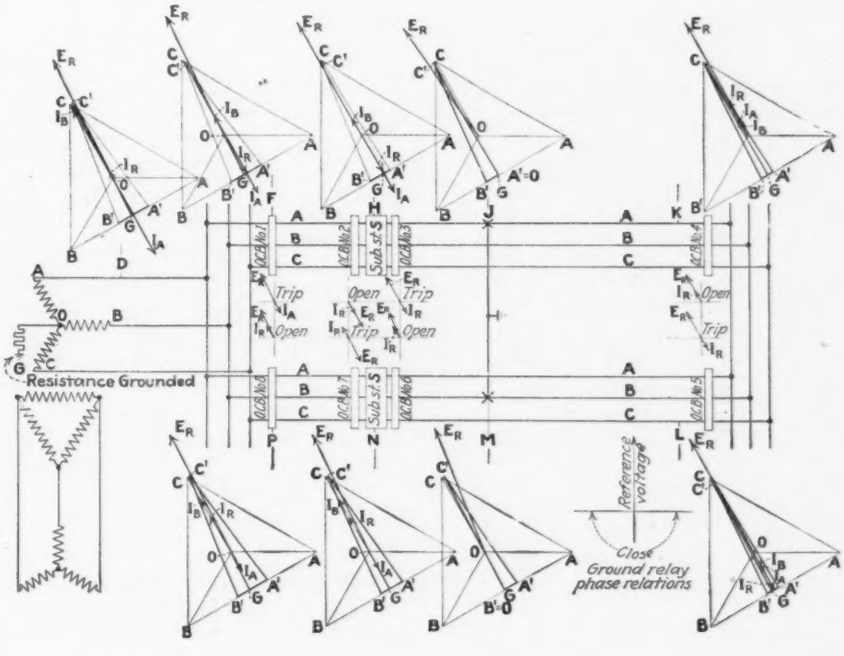


Fig. 4—The operating characteristics of the directional element of the ground relay in regard to the angular relation of the current and voltage received by the relay are shown in the polar diagram in the lower right-hand corner. This diagram indicates that the relay directional element contacts will close for any residual current leading or lagging up to 90 deg.

The vector conditions for the ground relay at location *F* are shown just below the oil circuit breaker at that place and by comparing the phase relations of the residual current and voltage with the polar diagram showing the operating conditions of the ground relay it may be seen that the directional element of the relay at location *F* will close its contacts. This is entirely proper. However, the relay at location *P* should also close its directional contacts since there is a ground fault on the line beyond the relay. This relay holds its contacts open.

Similar conditions exist at locations *H* and *N*. The residual voltages are approximately equal and in phase, but the residual currents are 180 deg. out of phase. Of course, the relays on either side of the substation have their potential connections reversed in order that one relay will hold its contacts open when the other closes contacts. As a result, the relay at substation *R* operates correctly and breaker No. 3 will be tripped out.

in Fig. 4. All other constants are the same for the two cases as well as the fault locations which are shown in Fig. 2.

Referring to Fig. 4, it may be seen that the vector conditions at the power transformer (D) present no unusual features beyond those of the familiar double fault to ground. Since both phase A and B are faulted to ground, the delta voltage AB has shrunk in value and the ground potential (G) has shifted away from the neutral (O) due to the relatively large neutral resistor. The currents flowing in phase A and phase B are nearly equal and opposite and differ only by the amount of current returning through the ground. This latter current (I_R) is small due to the 75-ohm neutral resistor.

The vector conditions at F and P are quite unusual. The phase currents are no longer equal and opposite, but at location F, phase A current is considerably larger than phase B current since the fault in phase B is further away. As a result, the residual current is nearly in phase and equal to phase A current and is much larger than the total zero phase sequence current as shown at location D. At the same time, approximately the opposite conditions prevail at location P. Phase B current is much larger than phase A current and the residual current is nearly equal to and in phase with the former. Since the two locations are at the same bus, the same voltage conditions must prevail and therefore the residual voltage is the same. Since the one residual current resembles phase A current, and the other phase B current, and the two are nearly 180 deg. out of phase, it follows that the directional element of one ground relay must open contacts if the other closes contacts.

Improper operation does result at substation S. The ground relay on the fault side of the station should clear the trouble, but its directional element is holding open. The relay which controls break No. 7 closes its contacts, and since its time setting would probably be low, this relay would trip the breaker and thus cut substation S away from the system.

Obviously, the ground relays at substation R would have operated improperly if the fault conditions had been reversed: that is, if phase A had been faulted at location M and phase B at location J.

There are two possible solutions to the problem: The design of a directional element with phase angle characteristics such that proper operation would result for both single- and double-phase faults to ground, and the use of proper auxiliary relays to lock out the ground relays for double faults to ground at different electrical locations.

The first scheme, while theoretically possible for some systems, would be difficult and expensive to accomplish. A complete mathematical study of the system would be necessary in order to determine the possible phase positions of the residual current and voltage for all types of ground faults. A directional element would then have to be developed with the proper phase angle relations to suit the conditions. Such an element would probably have to close contacts through a range of more than 180 deg., say 285 deg., and open contacts through the remaining 75 deg. as shown in Fig. 5. Relays for various systems would differ and probably the relays at different locations on a given system would have different phase angle characteristics.

The scheme of locking out the ground relays for a double fault to ground at different electrical locations is a practical one, and on a system grounded through a relatively high neutral resistor it is readily accomplished at small expense. Advantage is taken of the difference in magnitude of the residual current for the two types of faults.

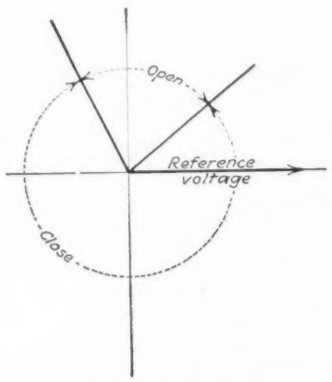
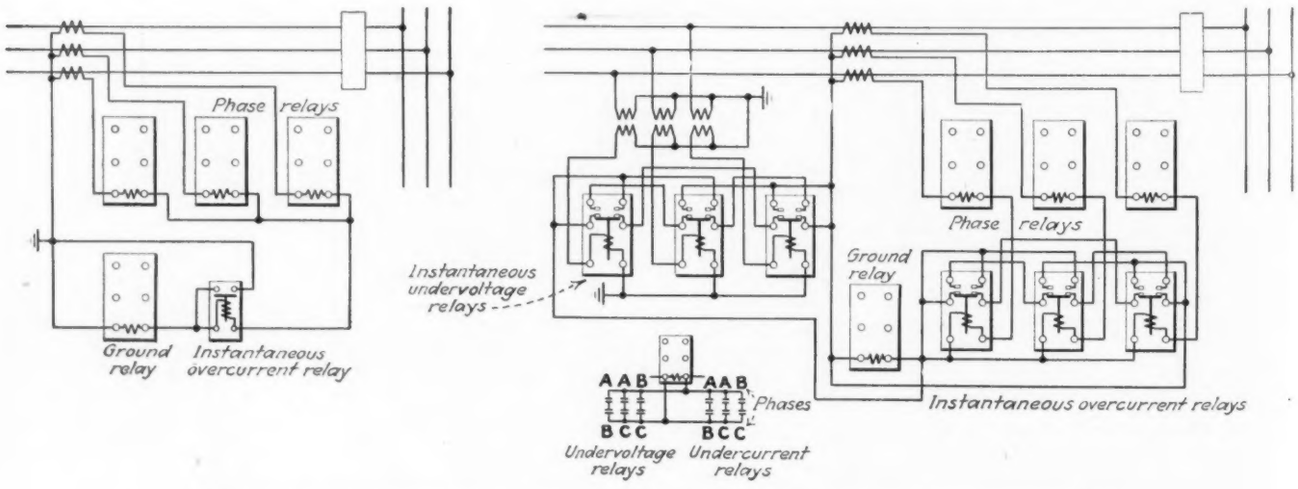


Fig. 5—Possible phase-angle characteristics

By referring to Fig. 4 it will be seen that residual current at location F and P is approximately 750 amp., while the total zero phase sequence current at location A is only 100 amp. and could not be greater than 200 amp. for a single-phase-to-ground fault due to the 75-ohm neutral resistor. Therefore, by connecting an instantaneous overcurrent relay in series with the ground relay in the residual circuit of the line current transformers and arranging the contacts of the former to short out the current winding of the latter, the ground relay may be restrained from operating as long as a double fault to ground at different electrical locations exists on the system. With the ground relays locked out the phase relays will either clear the trouble or sufficient circuit breakers will be opened to convert the trouble into one or more



Figs. 6 and 7—Method of locking out ground relay on resistance-grounded and solidly grounded system

single-phase-to-ground faults and the ground relays will then operate properly. The overcurrent lockout relay should be set to pick up on residual current slightly larger than the maximum ground current so that the ground relays may operate normally for single-phase-to-ground faults.

The lockout relay is best employed when its contacts short out the current circuit of the ground relay as shown in Fig. 6, for the latter relay cannot then start its timing operation until the double fault has been changed to a single-phase-to-ground fault, as evidenced by the residual current decreasing to normal ground fault value. Another advantage of this connection is that the unusually large double-fault-to-ground current is not allowed to pass through the ground relay. The latter usually is wound with many turns of fine wire in order to operate on small values of current, and could be easily damaged by the large double-fault current. For example, ground relays are often employed with taps from 0.5 to 2.5 amp., or even 0.2 to 0.8 amp., and are expected to operate on ground faults of 5 or 10 amp. secondary current, but on a double fault to ground, as shown in Fig. 2, the relay current could easily be 50 or 75 amp., or higher, if the line current transformer did not break down in ratio because of the heavy current.

The instantaneous overcurrent relay of Fig. 6 could be used to interrupt the potential circuit of the directional element, but unless the ground relays were directional-controlled, they would start their timing operations and several relays might complete this operation before the trouble were changed to a single-phase-to-ground fault. Then they might all trip out as soon as the various directional elements closed. If none of the relays were allowed to time until one or more circuit breakers were opened, they would operate selectively.

Inserting the contacts of the lockout relay in series with the tripping contacts of the ground relay has the same serious disadvantage as described above and, in addition, would place another set of contacts in the trip circuit, which is not good relay practice.

The problem of preventing faulty operation on systems grounded solidly is somewhat more complicated. By referring to Fig. 3 it may be seen that no simple relation exists between the value of the residual currents for the two types of faults. However, on a single-phase-to-ground fault, when the ground relays are expected to operate, high current or low voltage, or both, occur on only one phase, but on a double fault to ground, when the ground relays need not operate, high current or low voltage, or both, occur on two phases. Advantage of this characteristic may be taken to lock out the ground relays by installing auxiliary relays as shown in Fig. 7. The contact arrangement is such that high current or low voltage on two phases will lock out the ground relays. The same considerations regarding shorting out the current circuit of the ground relay apply as in Fig. 6.

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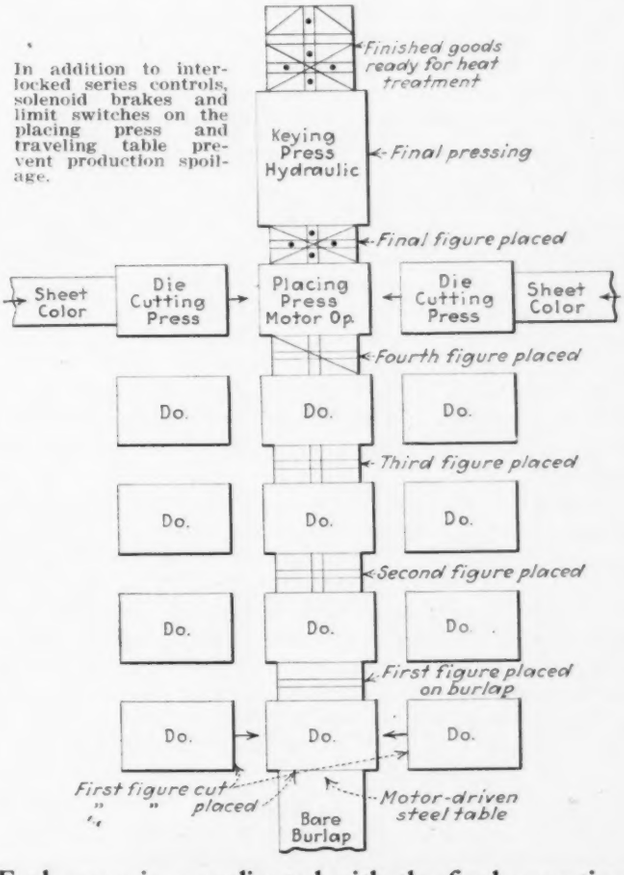
Limit Switches Co-ordinate Presses in Fabricating Work

IN MANUFACTURING linoleum of the machine inlay type two sets of five cutting and placing presses, preceding the calendering operation, must be so co-ordinated as to eliminate the possibility of faulty operations, with subsequent damage to production material. At the Trenton, N. J., plant of W. & J. Sloane this has been done through the use of limit switches and solenoid motor brakes.

Before the main driving motor, which makes one revolution for each position of the material on the press bed, may be operated, each position man must signal the chief operator by lighting a signal lamp on a suspended panel, but before the motor can be operated the series starting circuit must be completed through release of the presses at the five operating positions. Over-travel or under-travel of the press frame, vertically, is guarded against by limit switch applications.

A skillful use of a single limit switch, operated by the mechanical tripping of the main operating roll shaft, permits the elimination of costly mechanical clutches and faulty operations. The limit switch trips the operating circuit as the finger on the main operating roll shaft meets it and the solenoid brake stops the motor at precisely the exact spot required. As a single revolution of the main operating roll shaft amounts to 36 in. on the linoleum being fabricated good control is essential. A mechanical cam type contact-making arm further acts to insure exact design centering for each position; interlocking prevents hazardous or faulty operations.



Each press is co-ordinated with the final operation by interlocked motor controls

Two-Intensity Lighting for Merchandising

By M. LUCKIESH
Director Research Laboratory, National Lamp Works, Cleveland

ALTHOUGH levels of illumination at night are not generally as high in commerical establishments as can be economically justified, artificial lighting in the daytime is conspicuously inadequate. Good work has been done toward increasing the level of artificial illumination in show windows in the daytime to reduce the annoyance of daylight reflections from the glass of show windows. However, there is a large field in commercial establishments for high-intensity artificial lighting in the daytime. The solution may be two-intensity lighting installations by means of two-circuit fixtures or otherwise.

For example, a progressive operator of a chain of restaurants is interested in standardizing equipment, decorative scheme, exterior sign and other factors to make these establishments distinctive and of high attention value. The entire interior of these establishments is being correctly considered as a show-window trim. As such, the esthetic value of equipment and decorative scheme is important. By the same token artificial lighting becomes very important as it is already acknowledged to be in show windows. This operator has long appreciated some of the powers of artificial light. He believed in what he thought was high-intensity lighting for creating attention value and he had purposely avoided tearoom dimness under which customers are inclined to linger too long.

The artificial lighting for night time was fairly satisfactory, but its attention value has been given no consideration in the daytime. Viewing this chain of restaurants as show windows, the lighting specialist can suggest super-intensity of artificial lighting for the daytime. This idea can be executed by designing a two-circuit fixture for two-intensity lighting. Higher intensities of artificial lighting in the daytime than at night may be startling to many persons, but the idea is worthy of an attempt to extend it into many commercial establishments.

Contrast is very important in lighting as it is in many phases of living. What seems to be fairly good lighting at night is generally unsatisfactory during the day, when we are adapted to very high levels of illumination outdoors. In connection with this idea the lighting specialist may draw upon many experiences with the unsatisfactoriness of present low-intensity artificial lighting during those hours when it must compete with "low-intensity" daylighting, which in reality is at least of the same order of magnitude. In fact, on a foot-candle basis the latter is really high-intensity lighting when compared with prevalent artificial-lighting intensities. More light at night has long been the slogan of progressive lighting specialists. However, more artificial lighting during the day than at night is also a goal worthy of serious consideration.

READERS' FORUM

Wind, Not Lightning, Did It

To the Editor of the ELECTRICAL WORLD:

On April 8, 1930, the New York *Times* printed an article describing a lightning storm of April 7, and stated that lightning had struck Trinity Church in New York City and had loosed a pinnacle at the rear of the church, throwing it to the churchyard. Since Trinity Church is surrounded by very tall buildings, this appeared to be contrary to the theory that tall structures protect lower nearby structures from lightning strokes.

Investigation showed that the pinnacle which was dislodged had been located only about 20 ft. above the ground on a low extension at the rear of the church. This part of the structure was over-built not only by the main part of the church and the steeple but by many tall buildings surrounding the church property. Examination of the stones which had made up the pinnacle showed no signs of any burn such as would be expected if the pinnacle had been struck by lightning.

Wind, not lightning, dislodged pinnacle at the arrow like one to its right

The pinnacle and other parts of the church were apparently constructed of artificial cast stones, as pieces of foreign matter were found imbedded in the stone. Bars of a natural stone, which appeared to be slate, were cemented in holes at the ends of the larger pieces used in the pinnacle to act as dowels in holding the stones together. This slate was approximately $1\frac{1}{4}$ x $1\frac{1}{2}$ in. in cross-section and the "grain" of the slate was across rather than along the center line of the pinnacle. The joint at the base of the pinnacle had apparently become weakened and the slate "dowel" broken so that the heavy wind which accompanied the storm of April 7 blew the pinnacle over into the churchyard. It is felt, therefore, that lightning was not responsible for dislodging the pinnacle at the rear of Trinity Church on April 7.

H. S. WARREN.
American Telephone & Telegraph Company.

Men of the Industry

GEORGE MACDONALD was elected a director of the Cities Service Company at the recent annual meeting.

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H. C. CUMMINS, a director of H. M. Byllesby & Company, was elected a director of the Standard Gas & Electric Company at the annual meeting of stockholders.

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HAROLD F. KNEEN, who has been connected with the Lincoln Electric Company, Cleveland, Ohio, for the past year, has been appointed plant superintendent. C. J. BOWERS has been named production manager of the company's plant at Cleveland.

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T. W. FRECH, vice-president of the General Electric Company, with offices at Nela Park, Cleveland, has been elected to the board of the Electric Vacuum Cleaner Company of that city. Mr. Frech fills the vacancy caused by the death of A. K. Baylor.

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J. N. JUNKINS has joined the Stone & Webster Engineering Corporation, Boston, Mass., as engineer in the industrial division. For the past eighteen months he was engineer on plant improvements for the Atlas Tack Corporation, Fairhaven, Mass., and previous to that was a member of the firm of the Larkin Engineering Company, St. Louis, Mo.

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CLYDE C. WHIPPLE, assistant professor of electrical engineering at the Polytechnic Institute of Brooklyn, has been granted leave of absence for one year by the corporation of the institute to serve as visiting professor in electrical engineering at the Green school of engineering of Princeton University.

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JOHN R. REPLOGLE, electric refrigeration engineer and well known for his perfecting of many parts, systems and methods now employed in that branch of the electrical industry, has been named chief engineer of Copeland Products, Inc., Mount Clemens, Mich. Mr. Replogle was formerly chief engineer and one of the organizers of Nizer Corporation, merged about 1926 with Kelvinator. He remained with Kelvinator until 1928. In 1919-1920 he was chief engineer of Frigidaire, and previously was with Remy Electric and General Motors laboratories and Western Electric in engineering and research capacities.

H. C. Leonard Goes West

H. C. LEONARD, formerly manager of the electric department of the Virginia Electric & Power Company, Richmond, has left for Texas to assume the duties of general superintendent of the El Paso Electric Company. Mr. Leonard became associated with the Stone & Webster organization in 1919 and was one of the members of the group making the appraisal of the property of the Virginia Electric & Power Company. Upon completion of the work, he was transferred to the Boston office as designer. Shortly afterward he made a

connection with the Virginia Electric & Power Company in its engineering department, later becoming electrical engineer in charge of design of power station, substations and transmission lines. In 1927 he was promoted to manager of the electric department of the company in Norfolk, which position he held until early in 1930, when he was promoted to general manager of the electric department in Richmond.

Mr. Leonard is a native of Worcester, Mass., where he received his elementary education, later graduating with a degree of B.S. in electrical engineering from the Worcester Polytechnic Institute. Upon graduating he became connected with the General Electric Company in the testing and engineering department, during which time he continued his studies at Union College, where he received a degree of M.S. While in Norfolk Mr. Leonard was president of the Electric Club, vice-president of the Engineers Club and state chairman of the American Institute of Electrical Engineers.

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ROBERT W. LEEP, for some years a member of the engineering staff of the Eastern Oregon Light & Power Company, Baker, has resigned to become county engineer of Baker County, Ore.

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LEROY S. SCHELL has been appointed design engineer in charge of transformer engineering at the Erie plant of the General Electric Company, having been transferred from the engineering department of the Pittsfield plant, where he had been for twelve years.

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EDWARD D. KING, vice-president and general manager of the Tonawanda Power Company, has been elected a member of the board of directors. Mr. King is also assistant vice-president of the Buffalo, Niagara & Eastern Power Corporation.

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PROF. FRED A. FISH, who has been head of the electrical engineering department at the Iowa State College at Ames since 1909, has resigned. PROF. FRANCIS E. JOHNSON, who holds a similar position on the staff of the University of Kansas, has been named to succeed Professor Fish.

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JOHN H. DOBSON of Tempe, Ariz., has been elected president of the Salt River Valley Water Users' Association of Arizona to succeed F. A. Reid, retired. C. S. STEWARD is the new vice-president. The association controls the distribution of water and power from the Roosevelt, Horse Mesa, Mormon Flat and Stewart Mountain dams.

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HENRY L. DOHERTY, president of the Cities Service Company, celebrated his 60th birthday on May 15. Every year the staff of employees honors the occasion in a fitting way and this year's party took the form of an all-day outing at Asbury Park, N. J. Following a luncheon at the Berkeley-Carteret Hotel and the Monterey Hotel, a meeting was held in the Casino, where Mr. and Mrs. Doherty were greeted enthusiastically when they appeared on the platform accompanied by members of the executive staff. R. G. Griswold.

chief technologist, on behalf of the employees, presented to Mr. Doherty a platinum watch and chain. Mr. Doherty, who was visibly overcome by the warmth of the demonstration accorded him, made a brief response and, after thanking every one, told his hearers that the way in which he would have them co-operate with him one hundred per cent would be for them to co-operate to the fullest extent with one another.

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E. SALISBURY SMITH, for fourteen years securities manager for the Colorado division of the Cities Service Company, has resigned.

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MARTIN LEE CLARK was elected vice-president and secretary of the Niagara Electric Service Corporation following the meeting of the board of directors. Mr. Clark is also assistant general counsel of the Niagara Falls Power Company and Niagara Junction Railway Company.

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RALPH M. DOUGLASS, formerly advertising manager of Kelvinator Corporation and of Silent Automatic Corporation, domestic oil burner manufacturers, has been named director of advertising and sales promotion of Copeland Products, Inc., manufacturer of electric refrigeration, to succeed William S. Race, resigned.

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O. C. MERRILL of Washington, chairman of the American Committee for the World Power Conference to be held in Berlin June 16 to 25, sailed for Europe May 23 aboard the French liner *Paris*. He left to establish temporary headquarters for the committee at the Hotel Adlon, Berlin. On his way Mr. Merrill will stop in Paris for conferences with officials of the International Commission on Large Dams.

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DR. IRVING LANGMUIR, associate director of the research laboratories of the General Electric Company, received May 23 the Willard Gibbs medal of the Chicago section of the American Chemical Society, the award of which was announced in the February 15 issue of the ELECTRICAL WORLD. Dr. Julius Stieglitz of Chicago University presented the award.

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M. MONTGOMERY, formerly partner in the firm of Bartholomew, Montgomery & Company, Ltd., Vancouver, B. C., now known as Electric Power & Equipment, Ltd., has just organized a new electrical engineering company under the name of M. Montgomery & Company, Ltd. Mr. Montgomery will be president and managing director of the new company, which has its offices in Vancouver. The firm will carry on business as electrical engineers and dealers in power equipment.

Miles W. Birkett Heads Northwest Association

MILES W. BIRKETT, vice-president and general manager of the Washington Water Power Company, was elected president of the Northwest Electric Light and Power Association for the year 1930-31, at the annual meeting of the executive committee in Portland, May 17. Mr. Birkett has been engaged in the electric service industry since his graduation from the University of Wisconsin in electrical engineering. He entered the Washington Water Power Company in July, 1908, and became general manager of the company in 1922, being elected a vice-president in 1923. Mr. Birkett has been active in the affairs of the northwest association, which embraces the electric light and power industry in the states of Washington, Oregon, Idaho, Utah and Montana, and last year served as vice-president of the organization.

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CARL JAMES has been appointed engineering manager of the southern division of Allied Engineers, Inc., with headquarters in Birmingham, Ala. This division will absorb most of the personnel and carry on the work of the Dixie Construction Company and the Empire Construction Company, subsidiaries of the Alabama Power Company and the Georgia Power Company. F. O. WEISS has been named southern division construction manager.

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RICHARD H. VAN HORN, formerly assistant manager of the Bridgeport (Conn.) division of the United Illuminating Company, has been appointed manager of the division to succeed the late Frederick Cutts. A graduate of Brown University, Mr. Van Horn was connected with the Schenectady office of the General Electric Company from 1920 until 1924. In that year he went to New Haven and was engineer at the General Electric Company's office, associated with Mr. Cutts. When Mr. Cutts removed to Bridgeport as manager of the United Illuminating Company Mr. Van Horn went also as assistant manager. He is a member of the A.I.E.E.

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OBITUARY

Arthur J. Selzer

ARTHUR J. SELZER, commercial agent for the Westinghouse Electric Supply Company, New York, died suddenly May 25 while attending the convention of the National Electrical Manufacturers' Association at Hot Springs, Va. A prominent figure in the electrical supply field, Mr. Selzer had been commercial agent for the Westinghouse organization for the past four years. His early experience was obtained with the Varney Electrical Supply Company, Indianapolis, and with the Electric Appliance Company of Chicago. In 1915 he was appointed sales manager of the Central Electric Company, Chicago, and five years later assumed the general managership of the B-R Electric Company, Kansas City. It was in 1925 that he transferred his interests to the East as manager of the New York district of the Manhattan Electric Supply Company.

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GEORGE W. PATTERSON, 3d, associate dean of the University of Michigan College of Engineering, died at University Hospital, Ann Arbor, May 22, after an illness of two months. He had been on the Michigan teaching staff since 1889, being successively instructor, associate professor and junior professor of physics, junior professor and professor of electrical engineering. Since 1915 he had been professor of engineering mechanics.

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WILLIAM J. DELLES, executive engineer of the turbine engineering department of the General Electric Company, died at his home in Schenectady May 22, following a sudden attack of heart disease. Mr. Delles was to have sailed the following week as a delegate to the World Power Conference meeting in Berlin. A graduate of Mechanics Institute of Rochester, his native city, Mr. Delles entered the employ of the General Electric Company in the drafting department in 1898. Later he was made assistant to the manager of the Schenectady works, and in 1919 was transferred to the turbine department as assistant executive engineer.

Financial and Statistical News

LACK of any substantial indication of industrial recovery has added another dull week to the stock and bond markets. Volume of trading is approximately at low levels for the year. Current market letters intimate that second quarter earnings will probably compare less favorably with the second quarter last year than the first quarter compared with the corresponding first quarter. Last year's second quarter covered the peak of the boom period, however, and any direct comparison is misleading.

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Gains Continue in April

APRIL REVENUE OF ELECTRIC light and power companies promises to show an increase of about 2.5 per cent over 1929 and 12 per cent over 1928, if later reports continue the average indicated by those thus far received. The gain, though not large, means, nevertheless, that 1930 earnings have been greater, month by month, than those of any previous year. April showed a smaller increase than March when compared with 1929, but not when compared with 1928.

Companies in the Middle Atlantic States report a rate of gain rather above the national average; in the Southwest the situation is even better, but the great industrial area of the upper Mississippi Valley continues low when gains are measured from 1929, but is up with the rest of the country if 1928 is taken as a starting point.

Reported kilowatt-hour sales were larger than in 1929 in every one of the nine geographical regions except the East North Central, where they were 6 per cent smaller.

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New Capital Issues

KANSAS GAS & ELECTRIC COMPANY made an offering of first mortgage gold bonds priced at 93½ and interest, yielding about 4.85 per cent, a piece of financing involving a total of $16,000,000. These securities, dated June 1, 1930, mature June 1, 1980.

The Public Service Corporation of New Jersey has issued 150,000 shares of $5 cumulative preferred stock with the purpose of reimbursing its treasury for advances previously made to its subsidiaries for additions and betterments, and for other corporate purposes. These shares (ex-dividend payable June 30, 1930) were priced at $97.50 per share. Application has been made to list this issue of $5 cumulative preferred stock, numbering 150,000 shares, on the New York Stock Exchange.

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Utility Stocks Show Remarkable Recovery

PUBLIC UTILITY SECURITIES on the New York Stock Exchange and on the Curb have staged a remarkable recovery, as evidenced by the accompanying compilation, which includes a list of representative companies. On the basis of closing prices for May 15 this group was selling at an average of 22 times the per share earnings for 1929, the range extending from 11.2 to 36 times earnings. It is significant, however, that only one stock sold below fifteen times earnings out of the 21 stocks listed and that fourteen out of this total sold at more than twenty times the per share earnings for 1929. The price established May 15 marked a recovery of approximately 33.8 per cent of the loss in the November break and an advance of 56.5 per cent from the lows established at that time.

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Commonwealth & Southern Has New Management Plan

WITH THE FLOTATION OF Commonwealth & Southern Corporation of New York, a new co-operative management plan designed to give centralized service at cost has been put into operation by Commonwealth & Southern Corporation. The new plan replaces the series of management contracts formerly existing between holding company and operating units.

The stock of the new concern is divided entirely among the operating companies in the system in proportion to their gross earnings. Profits of the management concern are thus turned back to the operating units.

The new company has concluded a series of contracts with the operating companies to give them complete financial, supervisory and auxiliary services at estimated cost. The prices charged for these services are based pro rata on the gross earnings of the operating companies. Should the service be less ex-

PUBLIC UTILITY STOCKS GRADUALLY REGAINING POSITION

	1929 High	1929 Low	Closing May 15, 1930	Earnings per Share 1929	Times Earnings (May 15, 1930)
American Gas & Electric	225	70	145	6.11	23.7
American Light & Traction	399	190	304*	15.41	19.6
American Power & Light	176	64	106	5.12	20.7
American Water Works & Electric	199	50	112	4.00	28.0
Associated Gas & Electric	73	35	45	2.26	19.9
Columbia Gas & Electric	140	52	85	3.11	27.3
Commonwealth & Southern	25	10	18	.75	24.0
Commonwealth Edison	450	210	321	12.05	26.7
Detroit Edison	385	151	238	11.16	21.3
Electric Power & Light	87	29	89	2.98	29.8
Engineers Public Service	80	31	65	2.38	27.3
Middle West Utilities	565	159	34	1.88	18.1
National Power & Light	72	23	47	2.17	21.6
Niagara Hudson Power	31	11	22	.61	36.0
North American	187	67	120	5.03	23.8
Pacific Gas & Electric	99	42	70	3.52	19.9
Pacific Lighting	147	58	99	4.54	21.8
Public Service Corp. of New Jersey	138	54	115	4.19	27.5
Southern California Edison	93	45	67	3.44	19.5
Standard Gas & Electric	244	74	116	7.01	16.5
United Gas Improvement	60	22	46	4.12	11.2

*Split four for one.

pensive than the contracts call for, the profits will be allowed to accumulate and will be distributed to the operating companies in the form of dividends.

In this manner, it is stated, each operating company in the group has the advantage of combined buying power for apparatus, equipment and supplies; of technical services such as engineering, financial and legal service; of advertising, publicity and other public relations service, and of intangible services that the large organization maintained in New York City is able to give quickly and easily. None of the operating companies could afford to maintain so complete a staff at its own expense.

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Utility Companies Add to Directorates

SEVEN ADDITIONS TO THE DIRECTORATE of Buffalo, Niagara & Eastern Power Corporation have been announced. Floyd L. Carlisle, New York City; John J. Albright, Edward J. Barcalo, Edward B. Holmes, Col. William Kelly, William G. Schoellkopf and George P. Urban, all of Buffalo.

Louisville Gas & Electric Company has elected Victor Emanuel and Louis H. Seagrave to the board of directors.

Central Public Service Corporation has added D. F. McPherson and Omar P. Stelle to the board of directors.

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NEWS BRIEFS

Dissolution of the Eastern New York Utilities Corporation, formerly a subsidiary of the Mohawk Hudson Power Corporation, has been approved by the Public Service Commission of the State of New York.

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Public Service Corporation of New Jersey is making a new offer of its $5 cumulative preferred stock in a popular ownership campaign which will start June 2.

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Trustees of the Massachusetts Lighting Companies have offered stockholders of record May 21 rights to subscribe to 34,832 additional shares of common stock in the ratio of one new share at $50 for each four shares of common or preferred stock held.

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The board of directors of Montreal Light, Heat & Power Consolidated at a meeting held May 19 declared a dividend of 38 cents per share, this being at the rate of $1.50 per annum on the new no-par-value common shares of the company presently issued and paid up for quarter ending June 30, 1930, payable July 31 to shareholders of record on June 30. This dividend is equivalent to $3 per share on the old shares which carried a dividend of $2.40 per share per year.

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Eastern Group Generates Quarter of Nation's Energy

SERVING a large portion of the eastern half of the United States, the five-billion-dollar utility group in which United Corporation has segregated large minority holdings produces jointly more than one-quarter of the nation's power. United Corporation holds 27.9 per cent of the common stock of Columbia Gas & Electric Company, 26.9 per cent of United Gas Improvement, 17.9 per cent of Public Service Corporation of New Jersey and minority interests in Niagara Hudson Power, Commonwealth and Southern and Consolidated Gas of New York. The amounts held in number of shares are shown in table below.

	Shares
Niagara Hudson Power Corporation common	1,673,250
Niagara Hudson Power Corporation class A option warrants entitling holders to purchase 752,460 common shares; Niagara Hudson Power Corporation class B option warrants entitling holders to purchase 436,590 common shares; Niagara Hudson Power Corporation class C option warrants entitling holders to purchase 300,000 shares of common stock and to purchase class A option warrants entitling holders to purchase 100,000 shares of common stock.	
Public Service Corporation of New Jersey common	959,921
United Gas Improvement Company common	6,081,846
Columbia Gas & Electric common	245,263
Commonwealth & Southern Corporation common	1,798,270
Commonwealth & Southern Corporation option warrants entitling holders to purchase 1,005,000 shares of common.	
Consolidated Gas Company of New York common	202,900

GROWTH IN WATER-POWER INSTALLATIONS

Date	Horsepower	Increase	
		Horsepower	Per Cent
1921 (November)	7,926,958	.....	....
1924 (March)	9,086,958	(a)1,160,000	14.6
1925 (March)	10,037,655	950,697	10.5
1926 (January 1)	11,176,596	(b)1,138,941	11.3
1927 (January 1)	11,720,983	544,387	4.9
1928 (January 1)	12,296,000	575,017	4.9
1929 (January 1)	13,571,530	1,275,530	10.4
1930 (January 1)	13,807,778	236,248	1.7

(a) About 2.3 years. (b) About 0.8 year.

Small Increase in Capacity of Water wheels

THE TOTAL CAPACITY of waterwheels in water-power plants of 100 hp. or more in the United States on January 1, 1930, according to a report by the Department of the Interior, was 13,807,778 hp., an increase of 236,248, or 1.7 per cent, during 1929. This is the smallest increase in capacity for a number of years, as will be seen from the table. It should be noted, however, that water-power plants with a total capacity of 800,000 hp. are scheduled for completion in 1930.

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Tokio Utility to Be Reorganized

THE MANAGEMENT OF THE Tokio Electric Light Company, Ltd., the largest electric light and power company in Japan, will be reorganized as a result of the endeavors of Burnett Walker, vice-president of the Guaranty Company of New York. This company headed the syndicate which placed $70,000,000 worth of the Tokio company's bonds on the American market two years ago. Under the reorganization there will be a shift in the executive personnel, although Baron Go will retain the chairmanship of the board of directors. The outstanding capital of the company consists of $202,963,776 and the funded debt is $179,390,502.

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Cuba Has 144,126 Kw.

A TOTAL OF 144,126 kw., installed in 107 plants, is indicated in a report on electric light and power plants in Cuba, issued by the Electrical Equipment Division of the Bureau of Foreign and Domestic Commerce, and designated as Special Circular No. 597. In addition, more than 250 communities are listed as receiving energy at wholesale.

The report lists, for each plant, the name of the city or town, the owner, the capacity of prime movers in horsepower, the generator rating, the type of current, voltage, frequency, number of phases, and type of prime mover. The three largest plants are in Havana, 94,500 kw.; Santiago de Cuba, 7,000 kw., and Cienfuegos, 6,100 kw. There are a number of other sizable plants, but the majority are very small, many of them rated at 10 kw. or less.

Predominantly, the service is alternating current, 60 cycle, three phase, 110/220 volts. Steam and Diesel engines outnumber the other classes; only a very few hydraulic plants are listed.

Ontario Power Commission Reports Marked Growth

MARKED EXPANSION AND GROWTH is the keynote of the annual report of the Ontario Hydro-Electric Power Commission for the year 1929. During the year ten new generating stations were added to the system. Of these, the importance of the development of plants at Trethewey Falls and Elliott Chute and the purchase of the Bala Electric Light Company and Hanover Electric Light Company are stressed in the report.

Total power generated by all stations during the year was 4,340,315,196 kw.-hr., or 1,016,594 peak-load horsepower, with a normal operating capacity of 1,008,352 hp. The Queenston plant at Niagara Falls produced the largest single quantity, 525,469 hp.

An outstanding feature of the year's operation was the large increase in load in most of the systems. Peak load of all systems showed an increase over 1928 amounting to 16 per cent of the total. A large part of the increase in load was due to industrial consumers in the Niagara Peninsula. Despite this, however, all systems, except the Georgian Bay system, showed increases.

Construction work in rural power districts exceeded by a substantial margin that of any previous year. Some 1,004 miles of primary transmission lines were constructed and electrical services given to 6,277 new customers.

The capital expenditure approved for rural construction work was $2,668,241 and the aggregate peak load in October reached 21,138 hp. Arrangements have been completed for the construction of 1,500 miles of additional lines this year.

Reserves increased more than $10,000,000 during 1929, having reached the sum of $43,199,925 for municipal reserves and $43,857,000 for commission reserves.

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CURRENT EARNINGS REPORTS OF ELECTRIC LIGHT AND POWER COMPANIES

	1930	1929	Per Cent Increase	Operating Ratio 1930	Operating Ratio 1929
American Water Works & Electric & Subs. (Year ended March 31)					
Gross earnings	$54,688,149	$51,598,792	6.9	50	51
Net earnings	27,228,847	25,468,715	6.9	..	..
Cities Service (Year ended April 30)					
Gross earnings	52,650,042	36,902,526	42.5	..	..
Net earnings	51,071,832	35,708,912	43.0	..	..
Columbia Gas & Electric & Subs. (Year ended March 31)					
Gross earnings	106,013,731	104,338,793	1.6	49	48
Net earnings	54,196,668	54,276,063	—0.1	..	..
Detroit Edison (Year ended April 30)					
Gross earnings	56,374,386	54,310,117	3.8	66	65
Net earnings	18,799,737	18,934,809	—0.7	..	..
Engineers Public Service & Constituents (Year ended March 31)					
Gross earnings	51,464,589	37,632,835	36.6	57	58
Net earnings	22,127,590	15,793,337	40.0	..	..
Idaho Power (Year ended March 31)					
Gross earnings	3,940,357	3,570,602	10.0	49	47
Net earnings	2,016,748	1,880,611	7.0	..	..
Nebraska Power (Year ended March 31)					
Gross earnings	$6,110,776	$5,460,051	12.0	50	51
Net earnings	3,037,515	2,657,308	14.0	..	..
Pacific Power & Light (Year ended March 31)					
Gross earnings	4,722,937	4,793,112	—1.0	50	52
Net earnings	2,331,790	2,281,200	2.0	..	..
Pennsylvania Power & Light (Year ended March 31)					
Gross earnings	30,440,691	28,837,054	6.0	50	50
Net earnings	15,331,647	14,502,002	6.0	..	..
Public Service Corporation of New Jersey & Subs. (Year ended April 30)					
Gross earnings	138,876,580	128,453,938	8.1	..	..
Net earnings*	42,862,568	38,075,440	12.5	..	..
Southwestern Power & Light Subs. (Year ended March 31)					
Gross earnings	20,186,505	19,489,127	4.0	..	..
Net earnings	7,274,169	6,938,060	5.0	..	..
Utah Power & Light (Year ended March 31)					
Gross earnings	11,789,378	11,221,813	5.0	51	49
Net earnings	5,749,680	5,765,405	—0.0	..	..

*After operating expenses, maintenance, taxes and depreciation.

Business News and Markets

Upward Trend in Electrical Manufacturing

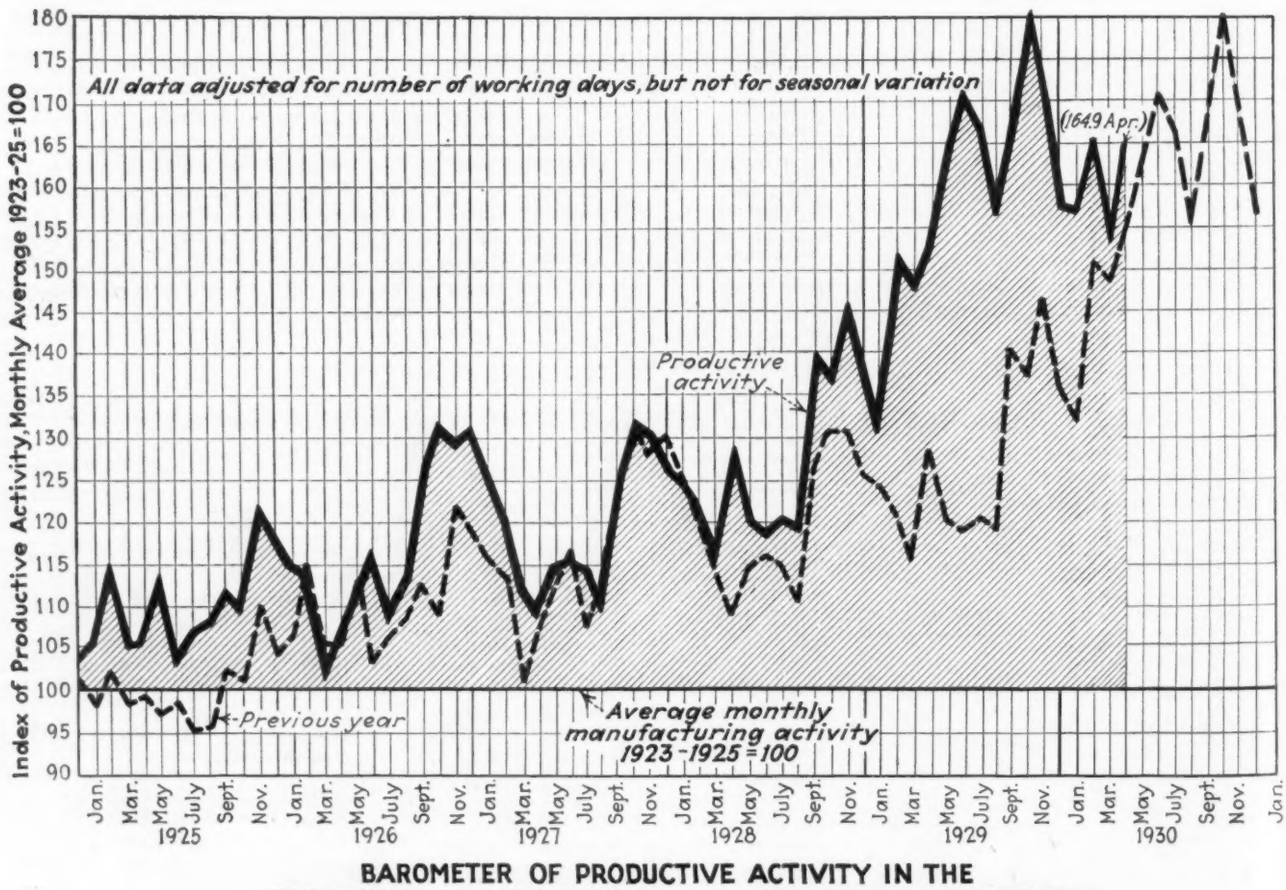
APRIL witnessed materially increased productive operations in the electrical manufacturing plants of the country. Reports on the consumption of electrical energy received by ELECTRICAL WORLD from a large proportion of the electrical manufacturing companies throughout the country indicate that the April rate of operations was 7.8 per cent above March and 6.7 per cent over April last year. The gain of April activity over that of March exceeded the normal seasonal increase for the period by about 11.3 per cent. Electrical manufacturing is one of the few industrial groups consistently reporting 1930 operations above those of the same period in 1929, the average gain for the first four months being 9.1 per cent over the same period last year.

The group of smaller electrical manufacturing companies appear to have witnessed a material increase in rate of operations during April, and to be currently operating on the highest plane so far reported this year. The April rate of operations in these plants was 15.2 per cent above March and 4.3 per cent above April last year. The average rate of operations of these smaller companies during the first four months of 1930 was 5.8 per cent above that during the same period last year.

On the other hand, the group of larger electrical manufacturing companies, which have been operating consistently on a very high plane this year, reported a drop in activity during April of 3.5 per cent as compared with March, but were still operating at a rate about 11.1 per cent over April last year. The average rate of operations of this group during the first four months of 1930 was 15.2 per cent above the same period in 1929.

Comparative indexes of productive activity in the electrical manufacturing industry as a whole based upon the consumption of electrical energy by these plants, adjusted for number of working days and referred to the period 1923-25 as 100, are shown in the following table:

April, 1930	164.9
March, 1930	153.0
February, 1930	165.2
January, 1930	156.2
April, 1929	154.6
Average first four months, 1930	159.8
Average first four months, 1929	146.5



BAROMETER OF PRODUCTIVE ACTIVITY IN THE ELECTRICAL MANUFACTURING PLANTS OF THE UNITED STATES

TRADE BRIEFS

The Associated Electrical Industries of Dayton, including the Dayton Power & Light Company, electrical wholesale supply houses, electrical contracting companies and electrical dealer-contractors, has been formed at Dayton, Ohio. The purpose of the association is mutual helpfulness through close association of members, and to present messages of an educational value regarding electricity and its uses through the daily papers.

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The Johns-Manville Corporation has announced the purchase of the assets and patents of the Stevens Sound Proofing Company of Chicago, manufacturer of patented structural products for sound insulating in walls, floors and ceilings and for constructing anti-vibration platforms under machinery.

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American Transformer Company, Newark, N. J., manufacturer of radio and industrial transformers, has appointed the Westburg Engineering Company, Chicago, and the Electric Apparatus Sales Company, Boston, as sales representatives in the Chicago and New England section respectively.

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For the quarter ended March 31, 1930, Kelvinator Corporation reports gross profit of $2,198,960, as compared with $1,495,791 for the similar quarter of 1929 and operating profit of $1,022,344 as compared with $456,286.

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Copperweld Steel Company has announced the appointment of the American Electric Company of Chicago and the Graybar Electric Company of New York as sole distributors throughout the United States of "Copperweld" rubber-covered telephone wire.

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Armstrong Electric & Manufacturing Corporation, Huntington, W. Va., announces the appointment of W. R. Herstein as vice-president with headquarters in Memphis, Tenn. Mr. Herstein will direct the activities of the company in the South and Middle West.

W. N. Matthews Corporation of St. Louis announces the establishment of a new sales office in the Lewis Tower Building in Philadelphia. J. Harvey Bonine and Charles S. Brangan, who operate under the name of the Bra Bon Electric Company, Inc., will be the Matthews representatives. The new Philadelphia sales territory will consist of all of the State of Pennsylvania, east of Altoona; all of the State of Maryland, east of Hagerstown; all of the State of Delaware, District of Columbia and southern half of New Jersey.

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The International Derrick & Equipment Company, manufacturer of electrical transmission towers and substations, railway floodlight towers, airport and airway equipment, etc., of Columbus, Ohio, has purchased the Leidecker Tool Company of Marietta, Ohio, manufacturer of oil field equipment. The Marietta concern will remain in that city and the present organization will be retained. For the present it will continue to operate under the name of the Leidecker Tool Company.

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EXPORTS OF ELECTRICAL EQUIPMENT (PRELIMINARY)

Article	March 1929	March 1930
Generators:		
Direct current—		
Under 500 kw.	$120,010	$73,865
500 kw. and over	72,381	69,385
Alternating current—		
Under 2,000 kva.	29,614	46,144
2,000 kva. and over	.....	116,121
Steam turbine generator sets	290,540	24,783
Accessories and parts for generators	96,977	75,046
Arc welding sets	.....	20,448
Self-contained lighting outfits	92,286	100,292
Batteries:		
Storage batteries	314,124	.....
6-volt storage batteries	.....	157,688
Other storage batteries	.....	106,900
No. 6 dry cell batteries	.....	50,861
Flashlight batteries	384,227	287,722
Radio B and C batteries (dry)	144,150	63,963
Other dry and wet cell primary batteries	184,164	33,271
Transforming or converting apparatus:		
Power transformers, 500 kva. and over	104,678	198,709
Distribution transformers, less than 500 kva.	111,162	252,367
Instrument transformers	14,036	15,893
Other transformers	140,297	206,687
Complete battery chargers under 15 amp.	27,298	14,239
Rectifiers, double-current and motor generators, dynamotors, synchronous and other converters	147,002	135,568
Transmission and distribution apparatus:		
Switchboard panels, except telephone	154,263	162,177
Switches and circuit breakers over 10 amp.	211,524	299,175
Fuses	56,560	41,686
Watt-hour and other measuring meters	124,826	55,419
Electrical indicating instruments	53,363	108,176
Electrical recording instruments	25,829	46,110
Other electrical testing apparatus	126,716	65,473
Lightning arresters, choke coils, reactors, and other protective devices	130,031	43,883
Motors, starters and controllers:		
Motors, ¼ hp. and under	269,096	226,372
Motors, over ¼ and under 1 hp.	84,402	64,330
Stationary motors—		
1 to 200 hp.	$363,103	$341,204
Over 200 hp.	11,109	61,021
Railway motors	84,290	57,437
Electric locomotives—		
Railway	15,070	94,138
Mining and industrial	39,019	44,211
Station and warehouse electric motor trucks	11,737	36,610
Starting and controlling equipment—		
For industrial motors	160,523	140,971
For electric railway and vehicle motors	8,260	17,718
Portable electric tools	147,504	117,496
Accessories and parts for motors	369,911	253,850
Refrigeration sets up to ½ ton capacity	1,137,568	.....
Refrigeration sets over ½ to 1 ton capacity	280,352	.....
Electric household refrigerators	.....	1,009,074
Electric commercial refrigerators up to 1 ton capacity	.....	235,249
Thermo dynamic refrigerators	.....	.....
Electric appliances:		
Electric fans	120,153	123,941
Electromechanical health exercisers	.....	15,569
Electric incandescent light bulbs—		
Metal filament	132,351	.....
For automobile, flashlight and Christmas trees	.....	17,302
Other metal filament bulbs	.....	94,161
Other electric lamp bulbs	70,202	56,708
Flashlight cases	325,920	156,857
Searchlights and floodlights	100,131	40,157
Motor-driven household devices:		
Electric household washing machines	189,769	165,880
Electric vacuum cleaners	82,291	88,530
Other motor-driven devices except tools	117,021	53,309
Electric flatirons	36,609	31,164
Electric cooking ranges	48,963	26,489
Other domestic heating and cooking devices	81,500	88,599
Industrial electric furnaces and ovens	68,253	149,324
Therapeutic and X-ray apparatus	173,500	148,082
Signal and communication devices:		
Radio apparatus—		
Transmitting tubes, sets, and parts	117,932	75,553
Receiving sets	$598,076	$676,604
Radio receiving tubes	206,581	192,116
Receiving-set components	262,015	188,910
Loudspeakers	156,590	126,352
Other receiving-set accessories, not elsewhere specified	145,704	68,123
Telegraph apparatus	104,004	54,394
Telephone apparatus—		
Telephone instruments	72,617	62,062
Telephone switchboards	49,520	206,865
Other telephone equipm't	227,312	477,557
Bells, buzzers, annunciators, and alarms	37,572	18,661
Other electrical apparatus:		
Spark plugs	239,992	206,744
Other starting, lighting and ignition equipment	295,611	160,275
Insulating material	159,210	159,179
Metal conduit, outlet and switch boxes	177,102	107,530
Sockets, outlets, fuse blocks, and lighting switches	209,654	185,755
Electric interior lighting fixtures	255,317	217,785
Electric street lighting fixtures	84,117	29,370
Other wiring supplies and line material	124,365	132,368
Other electrical apparatus, not elsewhere specified	1,351,539	1,146,639
Rubber and friction tape	41,517	29,885
Globes and shades for lighting fixtures	70,676	58,332
Glass electric insulators	38,443	33,000
Electrical porcelain:		
For less than 6,600 volts	84,083	45,930
For 6,600 volts and over	99,016	87,965
Carbons and electrodes:		
Electrodes for electric furnaces	180,540	200,482
Other carbon products	79,436	63,174
Insulated iron or steel wire and cable	43,740	38,041
Copper, bare wire	405,597	649,888
Insulated copper wire and cable	692,085	.....
Rubber covered wire	.....	94,118
Weatherproof wire	.....	15,745
Telephone cable	.....	15,355
Other insulated copper wire	.....	377,349
Totals	14,294,628	13,029,910
Three months ended March 31st	35,561,669	37,065,557

Market Conditions

GENERAL business conditions have not changed radically during the past week, a reasonable volume being sustained. In the East and on the Pacific Coast orders for large equipment were somewhat spotty.

——THE MIDDLE WEST REPORTS CONTINUED TO SHOW IMPROVEMENT, especially in the major activities, steel, automotive, railroad and electrical industries.

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PACIFIC COAST

—THOUGH BUSINESS IS ONLY FAIR, *several signs point that this is due to caution rather than conditions. For instance, despite poor retail business, collections are very good, and although large machinery ordering is held up, the orders for staple lines, such as meters, motors and small transformers, are running even with last year.*

Power company purchases include one carload of weatherproof wire, sizes No. 2 to 6, for Fresno, one-half carload of 1½ x 9-in. locust pins, one carload of 15,000-volt pin type insulators, one carload of 40-ft. poles for the Half Moon district and two carloads of 40-ft. poles for Pittsburg, one carload of No. 4/0 bare copper wire for Alameda and a $20,000 General Electric rotary converter equipment for Colusa. Street-lighting business is brisk, including a carload of assorted lead, rubber and cambric cable for Los Angeles park lighting, two $25,000 awards for Los Angeles jobs, a $17,000 award for San Francisco, a 50-light job for Oakland and two small fifteen-light jobs for willows and Oakland. Major building prospects are better, including a $1,000,000 civic center at San Diego, a $5,000,000 soap plant for Long Beach, a Shell oil by-product chemical plant near Martinez and additions totaling $700,000 to a Pasadena hotel. A 35-mile, 60-kva. power line to serve industrials is being planned for the San Luis Obispo district.

In the Puget Sound district apparatus and motor sales the past week were light, with indications of little improvement during early summer months. Sales reported included about $3,000 worth of miscellaneous switchgear to Seattle central stations, $1,000 worth of disconnecting switches to city of Tacoma, 35 motors from 75 hp. down to scattered industrials, ten from 50 hp. down to irrigation districts, five from 100 hp. down to a sawmill and about 30 from 75 hp. down to dealers. Bids were taken by the Washington Electric Company, a Stone & Webster subsidiary, for $1,000,000 worth of generators and in excess of $1,000,000 worth of transformers, switchboards, disconnecting switches, oil circuit breakers, etc., for Rock Island development, still being considered. Northwestern Electric Company will carry out a program of construction and power line extensions in Clark and Skamania counties, southwest Washington, this summer, one improvement calling for a 22-mile transmission line, and the city of Tacoma and Rainier National Park Company will spend about $25,000 for a power line in Mount Rainier National Park. Puget Sound Power & Light Company announced plans for another $10,000 substation in Seattle.

CONSTRUCTION PROJECTS

Pasadena, Calif., plans extensions and improvements in municipal electric light and power plant to cost $1,000,000. Oakland, Santa Ana, Ontario and Eureka, Calif., plan ornamental lighting systems. Ford Motor Company, Dearborn, Mich., will take bids for an assembling plant at Richmond, Calif., to cost $2,500,000. Pendleton and Bend, Ore., plan ornamental lighting systems. Oliver Power Company, Paonia, Colo., has secured local franchise and plans steam-electric power plant. Butte, Mont., has authorized call for bids for ornamental lighting system.

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SOUTHEAST

—BUYING OF ELECTRICAL MATERIALS *in the Southeast seems to have settled itself to current requirements and the tendency again is to mark time. However, a reasonable volume of business is sustained.*

The only order of perticular size reported this week was from a Georgia power company for high-tension insulators amounting to approximately $35,000. Some other central-station orders were for outdoor switching equipment amounting to $3,800 and a storage battery costing approximately $3,500. A power company in Tennessee ordered distribution transformers totaling $2,000 and an order for similar equipment amounting to $6,000 from South Carolina is in immediate prospect. A clay products company in Georgia ordered transformers, wire, poles and control equipment totaling $6,000 and a hotel in east Tennessee placed an order for a centralized radio system costing in excess of $6,000. A North Carolina town purchased a 150-kva. transformer and a middle Georgia town ordered distribution rehabilitation materials amounting to $1,500.

CONSTRUCTION PROJECTS

West Virginia Public Service Company, Fairmont, W. Va., plans transmission line from Webster Springs to Marlinton, W. Va., to cost over $50,000. Constructing Quartermaster, Fort Bragg, N. C., will receive bids until June 12 for installation of night flying system at Pope Field, as per plans on file. McMullen Aircraft Company, Tampa, Fla., plans installation of airport lighting system at South Jacksonville, Fla.

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MIDDLE WEST

—BUSINESS IN THE *Middle West section continues to show improvement. The volume of business increased somewhat and while considerable spottiness is still in evidence, general conditions are better. The major activities, steel, automotive, railroad and electrical industries, appear to have improved their positions somewhat, although conditions are not improved a great deal. Railroad equipment purchasing is holding up well and more construction work is being started.*

An interesting item is a $5,000,000 terminal for the C., B. & Q. railroad at Galesburg, Ill. Reports of the large mail order houses indicate an increase in sales, although total sales for the year so far are below a corresponding period last year. Agricultural implement manufacturers report a normal amount of activity. The various utility companies are busy with spring construction plans and all necessary work is being done. There has been a fair demand for apparatus, with a good demand for pole line hardware and distribution equipment.

Jobbers' sales are somewhat better. Some increase in industrial activity is noticeable, although general business is still quite spotty. Railroad business continues to hold up well. There has been a fair demand for most appliances without any outstanding exceptions..

CONSTRUCTION PROJECTS

West Allis, Wis., will receive bids until June 10 for an ornamental lighting system. Grand Rapids Store Equipment Company, Grand Rapids, Wis., plans plant at Los Angeles, Calif., to cost $300,000. Cracker

Jack Company, Chicago, Ill., plans candy factory to cost $750,000. Union Gas & Electric Company, Cincinnati, Ohio, contemplates power plant to cost over $1,000,000. North Dakota Power & Light Company, Mandan, N. D., plans transmission line to cost about $30,000. Duluth, Minn., plans ornamental lighting system. Minneapolis, Minn., contemplates ornamental lighting system to cost $100,000.

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NEW ENGLAND

—RECESSION IN SALES *of heavy electrical equipment in this district is reported. General scheduled materials remain steady in sales volume; some electrical specialties are active. Inquiries and negotiations are being received in fair volume.*

—SALES IN ELECTRICAL EQUIPMENT *during the past week were spotty; orders for heavy industrial equipment declined, though negotiations are being carried on for a number of large turbo-generator installations, and inquiries are being received by manufacturers for power plant requirements in districts outside New England.*

Small motor sales have declined, though the volume recorded by one manufacturer amounted to over $25,000. Steady demand is reported for fractional-horsepower motors. Small power generator sets are selling well and the general trend of scheduled materials is encouraging.

Central-station equipment sales are spotty; small orders rule and are confined to insulators, outside control and line hardware. One manufacturer notes a falling off in over-the-counter sales for small control equipment. Contractors' orders for new construction have slackened appreciably. Some electrical specialties, on the other hand, show improvement. The demand for electrically controlled traffic signals is gaining. Recently sales mounted in this district, according to one manufacturer, in excess of 25 per cent over last year. Interest in outside illumination for playgrounds is active; appropriations reaching about $4,000 were recently noted for new amusement park lighting. Special display electrical signs are gaining, and increased orders for lighting fixtures are predicted due to coming tercentenary celebrations.

CONSTRUCTION PROJECTS

Oxford Paper Company, Rumford, Me., has plans for power plant to cost over $90,000. Edison Electric Illuminating Company, Boston, Mass., plans power substation at Concord, Mass., to cost over $75,000. Norma-Hoffman Bearings Corporation, Stamford, Conn., will build an addition to ball bearing plant to cost $125,000.

EASTERN

—EQUIPMENT ORDERS CONTINUE *to show a higher level in the Eastern district, with central-station business giving better prospects for early commitments. While varied, demand trends toward substation apparatus and transmission line equipment.*

—INDUSTRIAL ACCOUNT GROWS *more active with regard to inquiries, indicating a better volume of orders soon to mature. Electric railway business shows a revival of demand of encouraging proportions. Jobbers of electrical products continue to report decreased sales.*

A feature of the week is the proposed steam-electric power project of the Public Service Electric & Gas Company, Newark, N. J., at Burlington, N. J., where site has been acquired for a 300,000-kw. station, to consist of five 60,000-kw. turbo-generators, initial installation covering two such units. The development will cost over $25,000,000 for expansion in South Jersey and will include a switching station in Pensauken Township, near Camden, to cost upward of $1,000,000.

A New Jersey power utility has purchased switchgear and allied equipment to an amount of $40,000. The Anglo-Chilean Consolidated Nitrate Corporation, New York, continues its purchases for a plant project in Chile, and has contracted with the General Cable Corporation for more than 600,000 ft. of copper wire and cable.

The Reading Company (Philadelphia & Reading Railway), Philadelphia, Pa., has authorized an appropriation of $300,000 for electrification of its Doylestown branch, making a total fund of $20,300,000 for such work in the Philadelphia district; a power substation will be built at Doylestown. The Baltimore & Ohio Railroad Company, Baltimore, Md., will install an automatic signal system on its Wheeling, W. Va., division. The Lehigh Valley Railroad Company has placed an order for two gas-electric rail motor cars, while the Minneapolis & St. Louis Railroad Company has purchased four such cars for early delivery.

A manufacturer of industrial motors and kindred equipment says that while sales are restricted, current demand shows an advance of about 10 per cent over last month; electric fan business is entering its season and the immediate outlook in that line is encouraging. Another maker of similar apparatus reports current account about equal to that of a year ago this time, inquiries are expanding and increased business is in sight. The Weirton Steel Company, Weirton, W. Va., a unit of the National Steel Corporation, has divided an order for electric drive equipment for new rail and structural mill between the General Electric Company and Westinghouse Electric & Manufacturing Company, involving more than $500,000.

CONSTRUCTION PROJECTS

Chemical Products Company, Patchogue, L. I., plans photo-film plant to cost over $500,000. Electro Metallurgical Development Company, operated by the Union Carbide & Carbon Company, New York, plans steam-operated electric power plant at Boncar, W. Va., to cost over $200,000. Port of New York Authority, New York, plans multi-story freight terminal to cost $10,000,000. Solvay Process Company, Solvay, Syracuse, N. Y., will carry out expansion program to cost $1,000,000. Delaware, Lackawanna & Western Coal Company, New York, will build a storage and distributing plant at Jersey City, N. J., to cost $400,000. New York Shipbuilding Company, Camden, N. J., plans expansion and improvement program to cost over $600,000. Board of Freeholders, Paterson, N. J., plans airport lighting system at county airport, Preakness, entire project to cost $200,000. Elliott Company, Ridgway, Pa., will build an addition to steam specialty plant to cost $250,000. Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until June 10 for 13,000 ft. insulated electric cable for the Philadelphia navy yard (Schedule 3492). Wilmington, Del., plans floodlighting system at municipal airport at Bellanca Field. United States Coast Guard Headquarters, Washington, D. C., will receive bids until June 2 for three Diesel engines.

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SOUTHWEST

—THERE HAS BEEN NO CHANGE *in general business conditions since last week. Manufacturers and utility operators report indications that business is again on the up grade. Some very large contracts are being figured and the volume of stock sizes of apparatus moved is holding up well.*

Contracts reported closed are as follows: A synchronous converter for a street railway in Oklahoma for $20,000, a miscellaneous lot of motors for a manufacturing plant costing $1,500 and a lot of transformers for a central station costing $3,500.

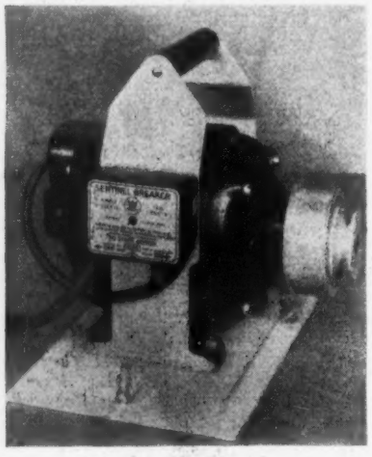
CONSTRUCTION PROJECTS

Board of Education, St. Louis, Mo., will take bids for central power plant to cost about $100,000. Shell Oil Company, St. Louis, Mo., plans oil refining plant at Burnaby, near Vancouver, B. C., to cost over $1,000,000. Washington University, St. Louis, Mo., plans electrical and mechanical school to cost $350,000. Valley Baking Company, Harlingen, Tex., plans baking plant to cost $250,000. New Orleans Public Service Company, New Orleans, La., will make extensions and improvements in power plants and system to cost over $1,000,000.

New Equipment Available

Portable Unit for Rural Service

A FRACTIONAL HORSEPOWER portable motor has recently been placed on the market by the Westinghouse Electric & Manufacturing Company. The portable unit consists of a kit of parts and a standard Westinghouse motor, selected



to meet the voltage requirements and other characteristics of rural electric service. The kit includes a motor base, as many fixed bases as are required, handle supports, pulley, Westinghouse "Sentinel" breaker for starting and motor protection and 15 ft. of flexible cord.

The fixed bases for this unit are fastened in place permanently on each machine to be driven. It is only a matter of a few seconds to make the change from one machine to another with this base connection. The motor base slides into the fixed base and is fastened rigidly in place by one thumbnut. Provisions are also made for belt-tension adjustments.

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Electrode for Dense Ductile Weld

AN ELECTRODE TO BE USED for welding the commonly called "18-8 Stainless Steels," which will be known as "Stainweld A," has been announced by the Lincoln Electric Company, Cleveland, Ohio. It is claimed that welds made can be of the same chemical content as the stainless steel itself, resulting in a dense ductile weld. This is accomplished by having the welding done in a protected atmosphere, thus excluding the oxygen and eliminating oxidation of the weld metal. The rod is coated with a material which in the intense heat of welding forms a gaseous envelope around the arc. It is used with reversed polarity and permits the making of a weld that is just as impervious to corrosion as the metal it joins.

"Stainweld A" is obtainable in three sizes, $\frac{1}{8}$ in., $\frac{5}{32}$ in. and $\frac{3}{16}$ in., of the regulation 14-in. lengths, and can be used for horizontal, vertical or overhead welding.

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Thermostat for Industrial Heating

A THERMOSTAT FOR USE with industrial heating units where very close control of the heat is not required has been announced by the General Electric Company. The new device is available in three principal ratings and the operating ranges are (1) 60 to 200 deg. F.; (2) 150 to 300 deg. F., and (3) 250 to 400 deg. F. The current-carrying capacity is 15 amp. at 115 or 230 volts alternating current, or $\frac{1}{4}$ amp. at the same voltages direct current. The thermostat will operate with a differential of 5 per cent of the maximum temperature range.

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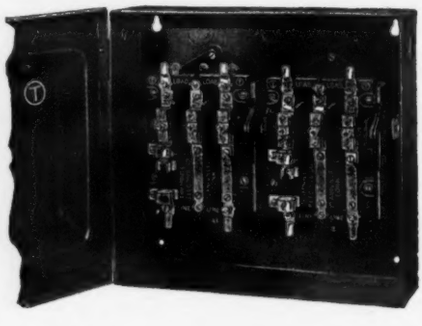
Magnetic Reversing Remote Control

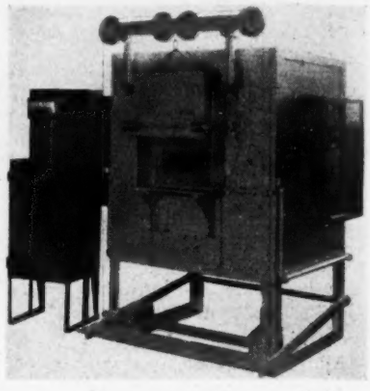
A NEW LINE OF MAGNETIC MOTOR reversing switches which consists of two standard Trumbull M-15 switches mounted in one cabinet with a mechanical interlock, so that it is impossible for



one switch to be thrown on until the other is off, has been announced by the Trumbull Electric Manufacturing Company, Plainville, Conn. Two switches are interlocked electrically so that both have to close at the same time and therefore operate as one switch. Both are supplied for remote control only.

High-Speed Steel-Hardening Furnace

A COMBINATION FURNACE designed for high-speed steel and cyanide hardening is announced by the Bellevue Industrial Furnace Company, Detroit, Mich. The heating elements are "Globar" brand, non-metallic, and therefore assure an effective, economical, uniform heating, it is claimed. This is a more simple type of furnace construction due to the simplicity of mounting the "Globar" element. The renewal of the electric element is simply a matter of a few



moments without any material loss of time or furnace service.

The furnace unit illustrated develops 25 kw. with seven "Globar" elements, which are placed partly below the hearth, the latter being 12 in. wide x 16 in. deep. Different standard designs are available with top heat, side heat and bottom heat, or combination, depending on the desired heating effect.

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SEVERAL CHANGES IN ITS MERCURY TYPE direct-current watt-hour meter (type HS-11) have been announced by the General Electric Company. Provision has been made for periodic renewal of the mercury. The cup, now made of metal, is built as one unit complete with rotor and mercury and is easily replaceable. This removes the necessity for disassembling and cleaning the mercury chamber. The voltage characteristic of the meter has also been improved. For uniformity of appearance the meters are furnished in the rectangular case used for other switchboard devices. The shunted meter is particularly well adapted where first cost, panel space or bus limitations are of major importance. Its principal advantages arise from the fact that it can be operated from a shunt and the heavy bus structure need not be carried directly to the meter.